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United States Department of Agriculture

Soil Conservation Service

Bismarck North Dakota

Flood Plain Management Study - Antelope Creek in Richland County, North Dakota

Prepared for the Richland County Water Resource District

In cooperation with the Richland County Soil Conservation District and the North Dakota State Water Commission

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FLOOD PLAIN MANAGEMENT STUDY

FOR

ANTELOPE CREEK

IN

RICHLAND COUNTY, NORTH DAKOTA

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Prepared By

United States Department of Agriculture
Soil Conservation Service
Bismarck, North Dakota

For the

Richland County Water Resource District

In Cooperation with the
Richland County Soil Conservation District
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North Dakota State Water Commission

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FOREWARD

This report defines the flood characteristics along and adjacent to the Antelope Creek in Richland County, North Dakota. Land uses along the stream are transportation, residential, commercial, industrial, agricultural, recreational and wildlife use. Despite moderate agricultural damage by floods in previous years, there is increasing pressure for development of the flood plain.

This cooperative report was prepared for the guidance of local officials in planning land use and regulating development within the flood plain. The 10-, 50-, 100- and 500-year frequency flood events were selected to represent degrees of major flooding that could occur in the future. The 100-year [1/] and the 500-year [2/] floods are frequencies considered for planning land use and development in the flood plain. Potential flooded areas are defined by flood hazard photomaps that show the approximate areas subject to inundation. Flood profiles show the water surface elevations for the selected events. Typical valley cross sections are presented to indicate ground levels across the width of the valley with the overlying flood depths. The flood profiles and flooded area photomaps are based on conditions at the time of the study.

This report does not imply any federal authority to zone or regulate use of the flood plain; authority to zone and regulate rests with state or local governments. Technical data provided are for the potential future adoption of local land use controls to regulate flood plain development. Since this report identifies flood problems, it will give guidance for the development,

1/ A flood which has a 1 percent chance of being equaled or exceeded in any year (also called "base" flood).

2/ A flood which has a 0.2 percent chance of being equaled or exceeded in any year.

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with environmental considerations, of flood damage reduction techniques such as flood control structures, removal of obstructions and flood proofing for use in an overall Flood Plain Management Program.

The assistance and cooperation of the Richland County Water Resource District, Richland County Soil Conservation District, North Dakota State Water Commission and private citizens in carrying out this study is appreciated.

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ANTELOPE CREEK FLOOD PLAIN MANAGEMENT STUDY

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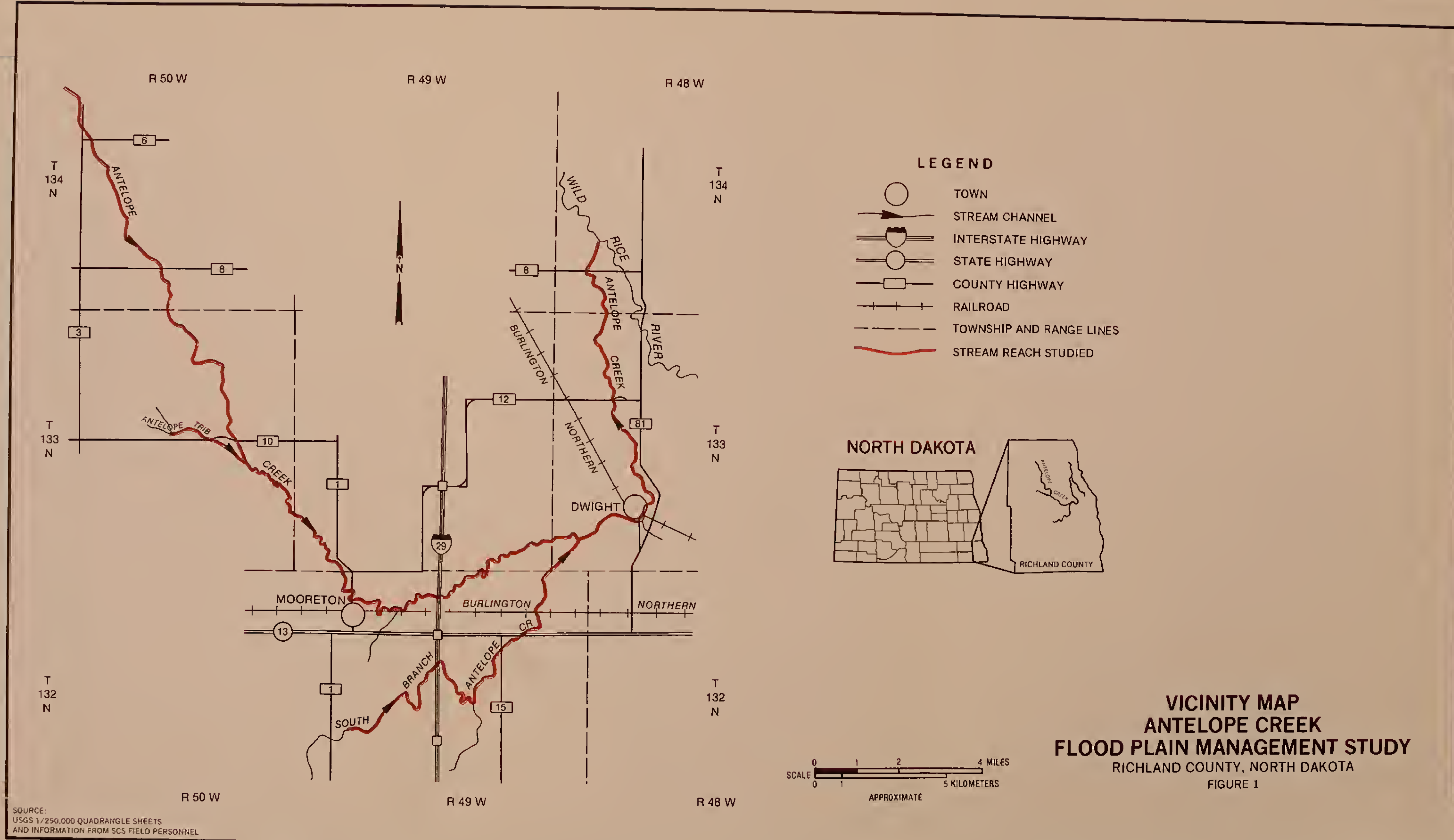

VICINITY MAP
ANTELOPE CREEK
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA
FIGURE 1

USDA-SCS-FORT WORTH, TEXAS 1984

INTRODUCTION

The purpose of this cooperative study is to identify flood hazard areas along the Antelope Creek in Richland County, North Dakota, and provide technical data necessary to implement an effective local flood plain management program. Increasing pressure to develop flood plain areas is becoming apparent as competition for land grows. Increasing land values and scarcity of undeveloped areas in which to expand often result in flood plain encroachment. Nonregulated development and encroachment frequently result in reduced flood conveyance, thereby increasing flood stages and overall flood losses.

Since the advent of federal laws governing financing within flood plains, many financial institutions are reluctant to lend and federal agencies cannot finance projects in these communities, unless there is assurance that the area is flood free or can be protected.

It is imperative that flood plains in agricultural areas be defined so that the planning and location of valuable properties can be controlled and areas identified where future flood control measures can be applied.

This flood plain management study was requested by the Richland County Water Resource District and the Richland County Soil Conservation District, through the North Dakota State Water Commission, under the 1978 Joint Coordination Agreement with the Soil Conservation Service. Priorities regarding such studies are set by the North Dakota State Water Commission. The study was carried out in accordance with the June 1981 Plan of Study between the Richland County Water Resource District, Richland County Soil Conservation District, North Dakota State Water Commission and the Soil Conservation Service.

The Antelope Creek Flood Plain Management Study consists of the Antelope Creek, the South Branch Antelope Creek, and the Antelope Creek Tributary. A total of 61.74 river miles were studied.

The Antelope Creek Study begins at river mile 0.00 (the confluence with the Wild Rice River at the east side of Section 30, T. 134 N., R. 48 W.) and proceeds upstream 46.0 river miles to the north section line of Section 7, T. 134 N., R. 50 W..

The South Branch Antelope Creek Study begins approximately 1.5 miles southwest of Dwight, ND (river mile 11.99 of the Antelope Creek) and proceeds upstream along the South Branch Antelope Creek 12.55 river miles (Center of Section 19, T. 132 N., R. 49 W.).

The Antelope Creek Tributary Study begins approximately 4.5 miles northwest of Mooreton, ND (river mile 30.52 of Antelope Creek) and proceeds upstream along the Antelope Creek Tributary 3.19 river miles (the west side of Section 15, T.133 N., R. 50 W.).

The "Extra Territorial Jurisdiction Law", passed by the 1975 North Dakota Legislature, provides communities with zoning authority outside the corporate limits. The 1981 North Dakota Legislature amended and re-enacted the law to include each quarter-quarter section within one-half mile of the corporate limits for incorporated cities with a population of 5,000 or less. The extra territorial jurisdiction for the cities of Dwight and Mooreton are covered by this study.

Flood plain management studies carried out by the Soil Conservation Service result from recommendations found in A Report by the Task Force on Federal Flood Control Policy, House Document No. 464 (89th Congress, second session), Recommendation 9(c), "Regulation of Land Use."

Authority for this study is provided by Section 6 of Public Law 83-566, authorizing the USDA to cooperate with other federal, state and local agencies in conducting investigations and surveys within watersheds of river and waterways, as a basis for coordinated programs. In carrying out this study, the Soil Conservation Service is responsive to Executive Order No. 11988, dated May 24, 1977, which directs that "all executive agencies responsible for programs which entail land use planning shall take flood hazards into account when evaluating plans and shall encourage land use appropriate to the degree of hazard involved."

Potential users of flood plains should base planning decisions upon the advantages and disadvantages of each location. Potential flood hazards are often unknown and consequently the managers, potential users, and occupants cannot always accurately assess these risks. In order for a local flood plain management program to be effective in the planning, development and use of flood plains, it is necessary for SCS to:

1. Assist the state and local units of government by preparing appropriate technical information and interpretations for use in their flood plain management programs.

2. Provide technical services to managers of flood plain property for present and future land uses.

3. Improve basic technical knowledge about flood hazards in cooperation with other agencies and organizations.

This report contains aerial photomaps, water surface profiles and typical valley and channel cross sections indicating the extent of flooding which can be expected within the study areas. The 10-, 50-, 100- and 500-year frequency flood discharges and elevations are included.

The North Dakota State Water Commission or the Soil Conservation Service will, upon request, provide technical assistance to federal, state and local agencies and organizations in the interpretation and use of the information contained in this study.

DESCRIPTION OF STUDY AREA

The study area of the Antelope Creek Flood Plain Management Study is located in the Water Resource Council's Souris-Red-Rainy Region and Subregion 09020105.

The temperature range within the study area is large from summer to winter, and on occasion from day to day. In the winter, outbreaks of arctic air brings bitter cold. Most winters have many days with temperatures below zero. The mean temperature for the winter months of December, January and February is 12.6°F. Summers are warm and pleasant. The average temperature for the summer months of June, July and August is 69.3°F. Average annual precipitation is about 20 inches.

Antelope Creek has its source on an extensive delta, which was deposited by the Sheyenne River in former glacial Lake Agassiz. The creek meanders its way southeastward across the delta for about 15 miles to the City of Mooreton where it turns northeast. About 4 miles northeast of Mooreton it begins to meander across the nearly level, featureless glacial Lake Agassiz lacustrine plain. The south branch of Antelope Creek joins Antelope Creek about 1.5 miles southwest of Dwight, ND. Here Antelope Creek turns abruptly north and joins the Wild Rice River about three miles east of the City of Galchutt, N.D.

Soils on the delta are nearly level, moderately well drained to poorly drained, moderately coarse textured and medium textured formed in loamy and silty lacustrine sediments. Those on the lake plain are nearly level, somewhat poorly drained and poorly drained, medium textured to fine textured

formed in silty and clayey lacustrine sediments. Some soils are shallow over a sodic claypan subsoil.

NATURAL VALUES

The Antelope Creek Flood Plain Management Study Area consists of the flood plains and adjacent uplands. Land use for the study area consists of agricultural, commercial, farmstead, recreation, residential, transportation services, and wildlife land.

The agricultural land includes small grain and row cropland, rangeland, pastureland, hayland and farmsteads including associated structures and facilities. Prime farmland constitutes 60 percent of the study area. More than half that acreage has been converted to prime farmland by applied drainage. Of the prime farmland within the study areas, 75% occurs within the flood plain, of which cropland is the dominant land use. The remaining 25% prime farmland acreage, in the study area, occurs outside the flood plain. Cropland is again the dominant land use. Antelope Creek and its tributaries have numerous constructed open channels outletting into them.

Commercial land contains businesses, underground and surface utilities, streets and alleys in Mooreton and Dwight.

Recreation land in the study area occurs as city park facilities within or near the towns of Mooreton and Dwight.

Residential land uses include permanent dwellings in Mooreton and Dwight.

Transportation services land included in the study area are roads, streets, highways, railroads, utility rights-of-way and other transportation facilities.

Wildlife land uses in the study area occur almost entirely as secondary uses to the primary land uses listed previously. These areas occur along scattered reaches of the creek and its tributaries as remnant herbaceous/woody patches.

Flood plains including the remaining approximate 150 acres of type 1 and 2 wetlands have the potential of producing riparian vegetation which furnish breeding, escape, and rearing habitat for big and small game, furbearers and other wildlife; spawning and nursery areas for fishes, amphibians and aquatic invertebrates; and a high yield food source for many resident and migratory species.

Riparian areas of the Antelope Creek study area have been extensively encroached upon by agricultural operations. These operations have extensively reduced the wildlife habitat value of the study area. Because riparian areas have such high value to wildlife as habitat, the need to restore/protect these areas is strongly recommended.

There are planted windbreaks in the study area that add habitat value to the area, however these plantings do not exhibit the habitat quality of naturally occurring tree/shrub species and their associated surroundings.

Woody and herbaceous species occurring in the area include boxelder, willow, cottonwood, Siberian elm, green ash, American elm, quaking aspen, basswood, bur oak, Russian olive, chokecherry, juneberry, wild plum, dogwood, western snowberry, sedge, prairie cordgrass, reed canarygrass, smartweed, Baltic rush, sunflower, goldenrod, aster, Jerusalem artichoke, northern reedgrass, big bluestem, green needlegrass, porcupine grass, needle-and-thread grass, bearded wheatgrass, Canada wildrye, prairie dropseed and Kentucky bluegrass.

Some of the wildlife apt to utilize the study area include gray partridge, pheasant, mourning dove, migratory waterfowl, raccoon, badger, skunk, red fox, bat, thirteen-lined ground squirrel, eastern fox squirrel, mink, beaver, deer mouse, meadow vole, muskrat, eastern cottontail, whitetail deer, snapping turtle, gartersnake, tiger salamander, great plains toad, chorus frog, and leopard frog.

This creek is not, nor is it proposed to be, listed in the National Wild and Scenic Rivers System. No critical habitat for threatened and endangered species was identified in the study area.

The 1978 Stream Evaluation Map - State of North Dakota classified Antelope Creek as a Class III (a substantial fishery resource). The creek outlets into the Wild Rice River (a Class II high priority fishery resource) at lower end of the study area.

FLOOD HISTORY

Most of the flooding occurs in the spring of the year, usually in April. Large floods occur from spring snowmelt runoff due to winter accumulation of snow and frozen soil conditions. Figures 2 through 9 show photographs of recent floods. Large floods in recent years occurred in 1943, 1951, 1952, 1969, 1975 and 1979.

FLOOD POTENTIAL

Potential flood areas within the Antelope Creek Watershed include primarily agricultural land. A limited number of homes and grain storage facilities are subject to inundation during a 100-year frequency flood event. Flood damages include loss of stored grain, eroded land, sediment deposition, washed out fences, weakened roads and bridges, water-soaked buildings and personal property.

Restrictive bridges, culverts, dense vegetation and sharp meanders in the channel all contribute to the severity of flooding within the flood plain.

Floodwaters in the Antelope Creek rise rapidly. Duration of flooding normally ranges from 2 to 6 days for significant flood events.

A 500-year frequency flood will inundate approximately 7400 acres, including 12 farm homes; all or a part of 28 farmsteads; 3 homes in Dwight; 34 homes in Mooreton and 37 road crossings (28 bridges and 9 pipe crossings). A 100-year frequency flood will inundate approximately 5100 acres, including 4 farm homes; all or a part of 16 farmsteads and 34 road crossings (25 bridges and 9 pipe crossings).

Figures 10 through 46 show potential flood stages at various locations of the study area.

FLOOD PLAIN MANAGEMENT

With flood hazard information, the cities and county can minimize future flood losses by planning for the protection, wise use and orderly development of the flood plain area. The overall plans of the communities for industrial, commercial and residential areas, streets, utilities, parks and schools must recognize the need to temporarily store (if possible) and convey floodwaters.

A coordinated planning procedure such as this is a vital part of any comprehensive flood plain management program. Effective flood plain management involves public policy and action for the wise use and development of the flood plain. It also includes such measures as collection and dissemination of flood control information, acquisition of flood plain lands, construction of control structures and enactment of ordinances and statutes regarding flood plain land use and development.

A viable local flood plain management program is comprised of numerous elements, some of which are: structural flood control works to protect existing development; regulations to guide new development; flood insurance to protect existing and new buildings; and individual protection measures such as flood proofing.

Flood Control Measures

Various structural flood control measures to reduce the flooded area include enlarged bridge openings, dikes, floodwater retarding dams, floodways and channel work, or a combination of the above.

Flood Plain Regulations

Flood plain regulations are designed to permit realistic use of flood plain areas without increasing potential damage. Among the various elements used to accomplish this are zoning ordinances, subdivision regulations, building codes, and sanitary and utility regulations. For a guide, see "A Perspective on Flood Plain Regulations for Flood Plain Management", Corps of Engineers' Manual EP 1165-2-3-4.

Flood Insurance

Under the National Flood Insurance Act of 1969 (PL 90-448), the Federal Emergency Management Agency (FEMA), Federal Insurance Administration (FIA), is authorized to carry out a National Flood Insurance Program (NFIP), which makes flood insurance coverage available to all walled and roofed structures and their contents used for residential, business, religious and agricultural purposes, buildings occupied by nonprofit organizations and those owned by state or local governments or their agencies.

The unincorporated areas of Richland County currently participate in the National Flood Insurance Program. In this area, owners and occupiers of all buildings and mobile homes are eligible to obtain flood insurance coverage. It is recommended that persons within or adjacent to the delineated flood hazard areas maintain flood insurance on both the structure and contents.

Further inquiries about the flood insurance program should be directed to the Office of the State Engineer, North Dakota State Water Commission; the official state coordinating agency for flood insurance.

Other Measures

Land use and other regulatory controls including zoning, subdivision regulation and building codes play an important role in flood plain management. It is also important that the community takes action to implement other programs and measures to supplement these controls. A few possible measures to protect and control developments in flood prone areas are: (1) open space land acquisition programs, (2) urban renewal programs, (3) preferential tax assessment, (4) flood proofing of existing structures and (5) public policy governing the construction of utilities and public facilities such as bridges and streets.

The Office of the State Engineer, upon request, will provide assistance in flood proofing techniques, the implementation of a flood warning system and establishment of a local flood data collection program.

Recommendations

Some recommendations for alleviating the flood situation along the flood plains of the Antelope Creek and tributaries are:

1. Adoption of local land use and zoning regulations for all flood plain areas. The purpose of flood plain regulations is to control development on the flood plain consistent with nature's needs for conveyance of flood flows.

2. Flood proofing existing or future buildings that otherwise cannot be adequately protected. (See U.S. Army Corps of Engineers "Manual of Flood Proofing Regulations", EP 1165 2 314 and "Elevated Residential Structures Reducing Flood Damage Through Building Design: A Guide Manual", published by the Federal Insurance and Hazard Division, HUD).

3. Installation of a dike system to protect extensively developed flood plain areas (especially residential, farmsteads and other buildings).

4. Increase the areas of bridge and culvert openings to minimize the restriction of large floods.

5. Improve hydraulic characteristics of channels through enlargements, oxbow cutoffs and active maintenance programs consistent with environmental guidelines.

6. Construct upstream floodwater retarding dams, as feasible, to retard flood flows. None appear to be economically feasible under SCS criteria.

Figure 2 - 1962 Flood at Mile 6.94
Photo by Dwight Anderson

Figure 3 - 1969 Flood at Mile 10.25
Photo by Glen Lund

Figure 4 - 1975 Flood at Mile 24.05
Photo by Charles Klosterman

Figure 5 - 1962 Flood at Mile 32.84
Photo by John Williams

Figure 6 - 1962 Flood at Mile 36.05
Photo by Harold Langseth

Figure 7 - 1975 Flood at Mile 42.44
Photo by Ray Anderson

Figure 8 - 1975 Flood at Mile 42.75
Photo by Ray Anderson

Figure 9 - 1962 Flood at Mile 42.44
Photo by Ray Anderson

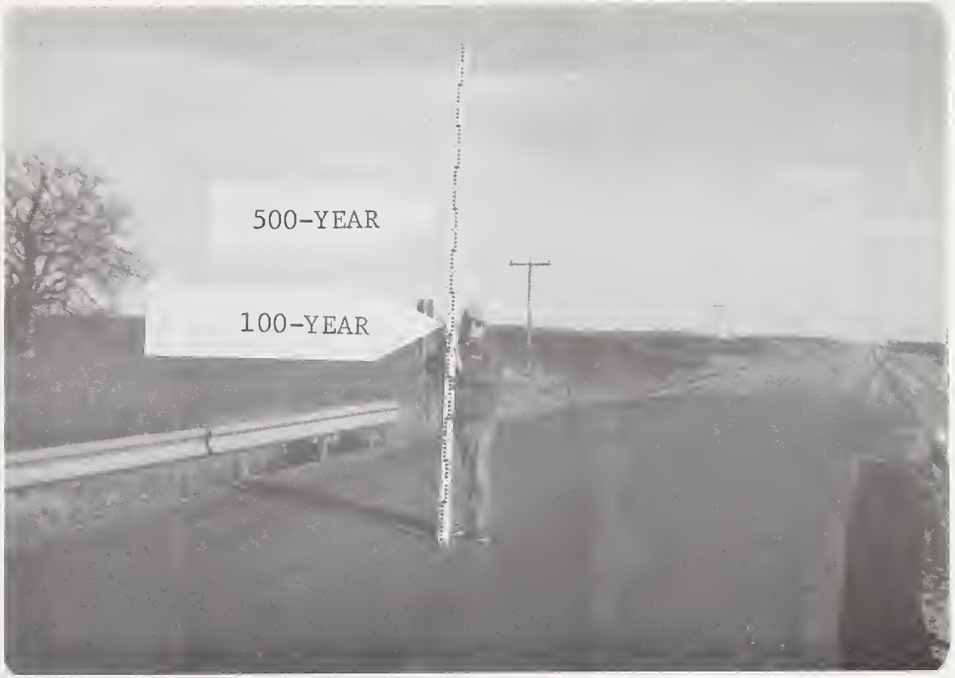

Figure 10 - M 0.88 Sections 30 & 31, T. 134 N., R. 48 W.

Figure 11 - M 1.66 Sections 31 and 32, T. 134 N., R. 48 W.

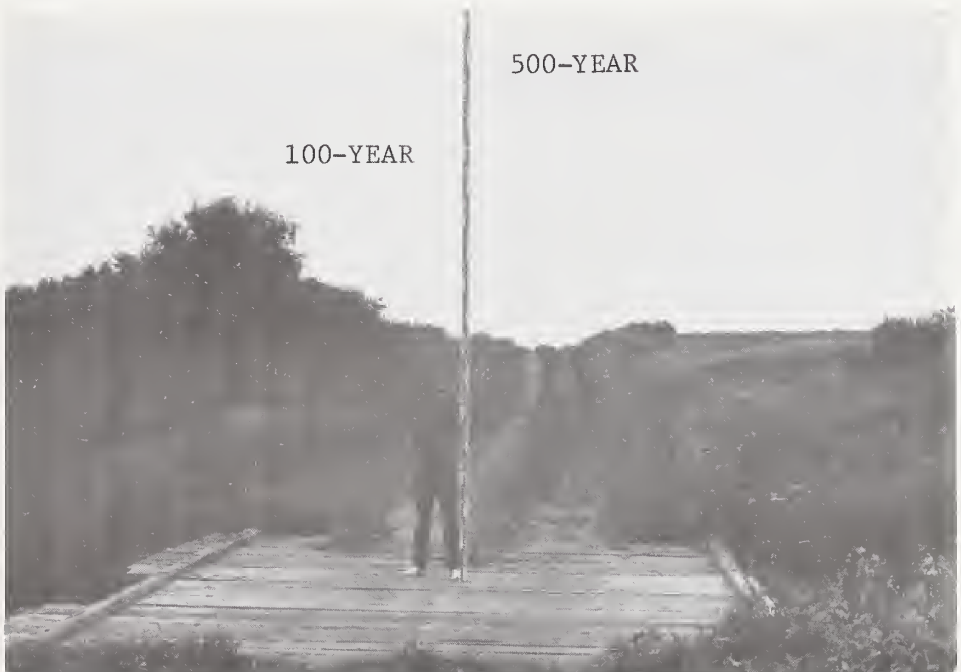

Figure 12 - M 2.61 Sections 31, T. 134 N., R. 48 W. and 5, T. 133 N., R. 48 W.

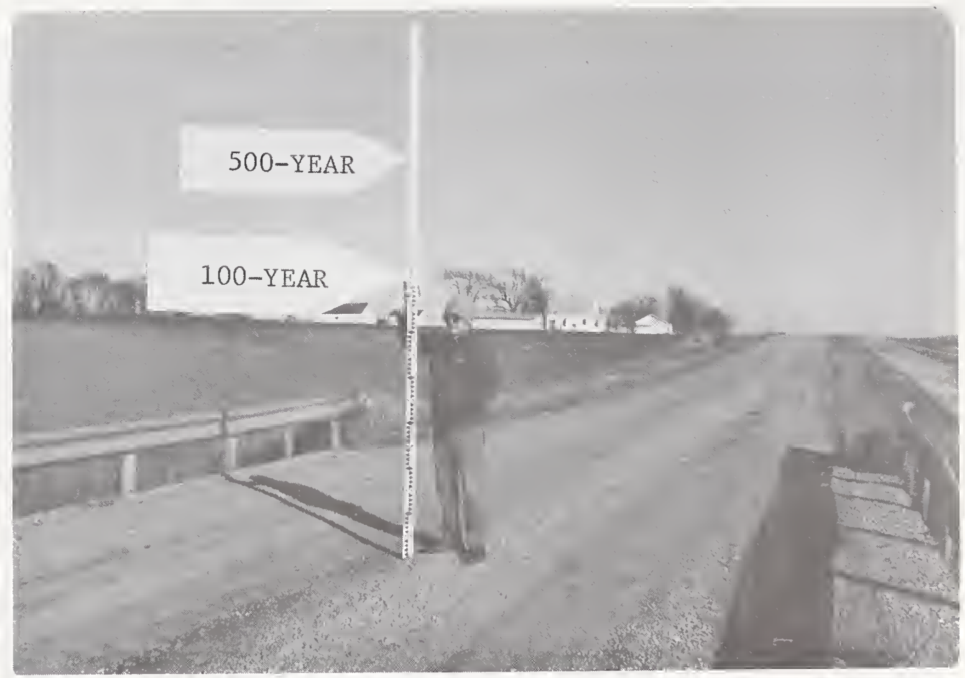

Figure 13 - M 5.20 Sections 8 and 17, T. 133 N., R. 48 W.

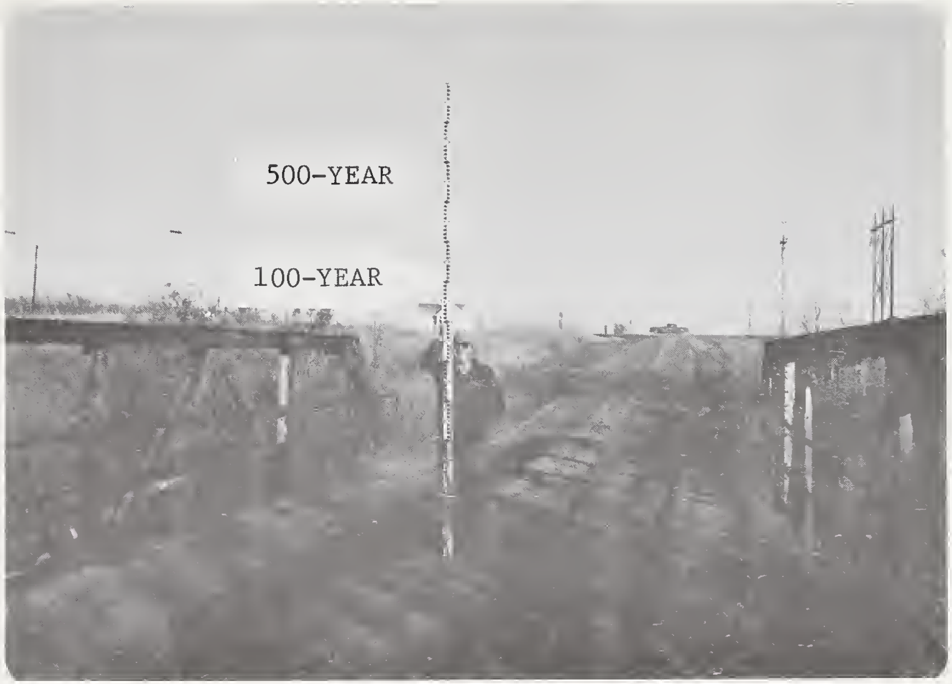

Figure 14 - M 6.94 Sections 17 and 20, T. 133 N., R. 48 W.

Figure 15 - M 8.75 Sections 21 and 28, T. 133 N., R. 48 W.

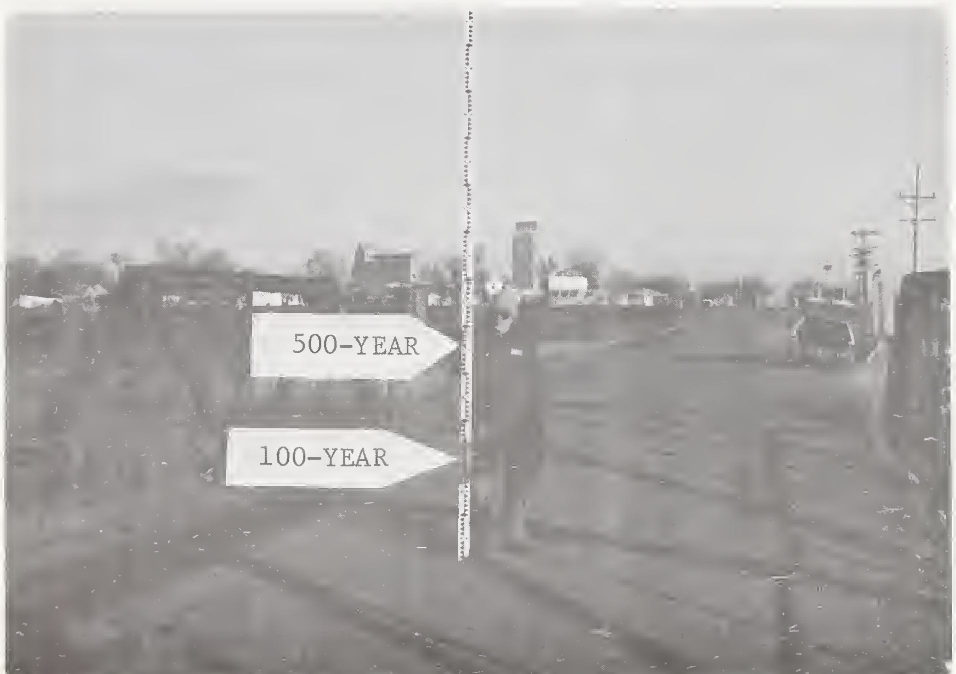

Figure 16 - M 10.22 Sections 28 and 29, T. 133 N., R. 48 W.

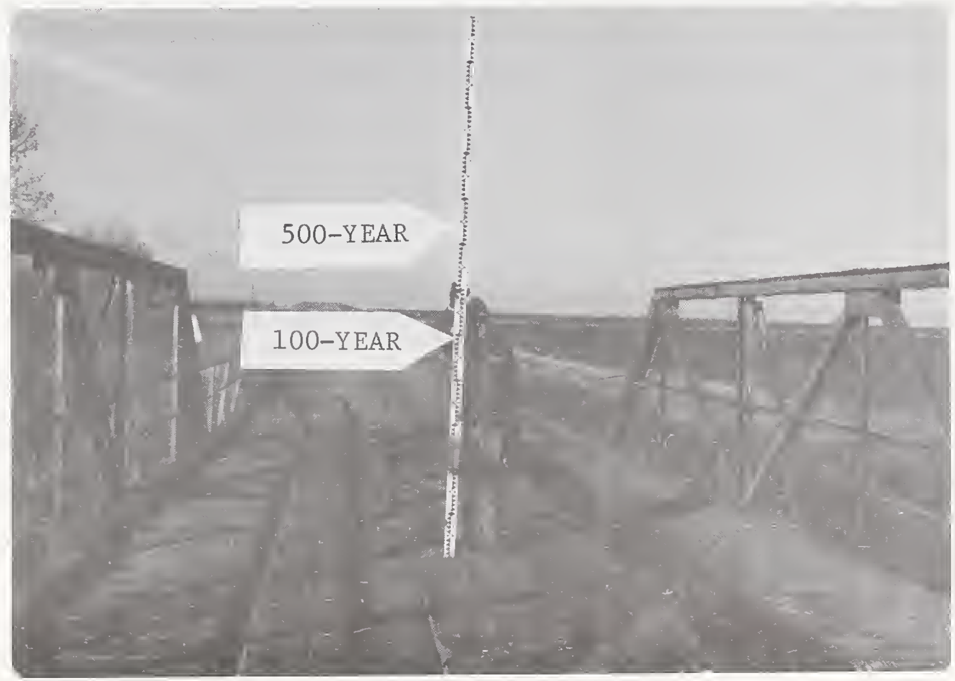

Figure 17 - M 11.42 Sections 29 and 32, T. 133 N., R. 48 W.

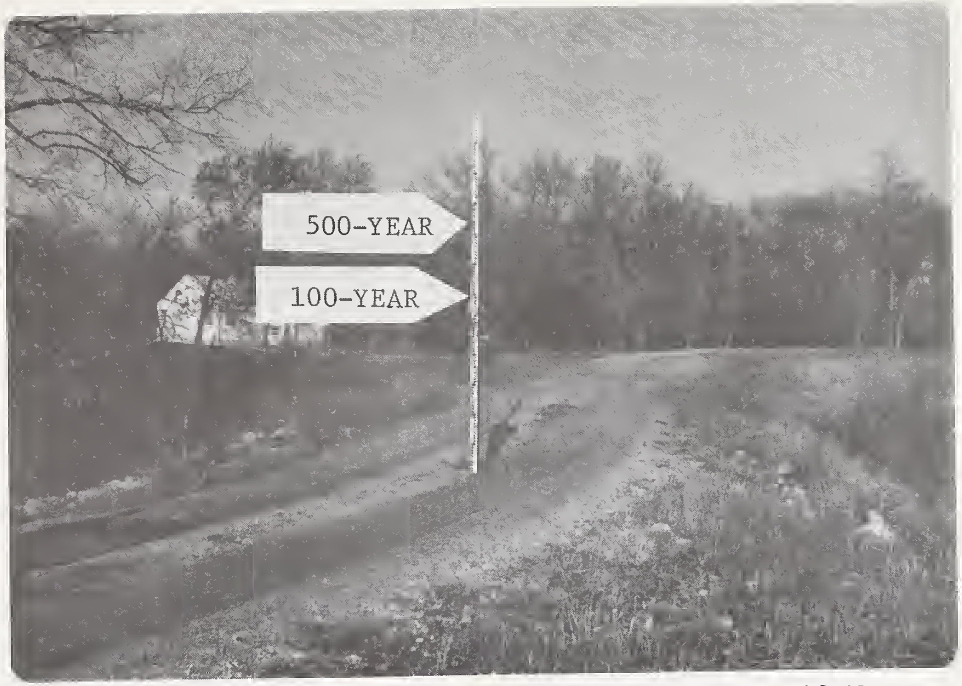

Figure 18 - M 12.93 Sections $\frac{\text{36 T. 133 N., R. 49 W.}}{\text{31 T. 133 N., R. 48 W.}}$

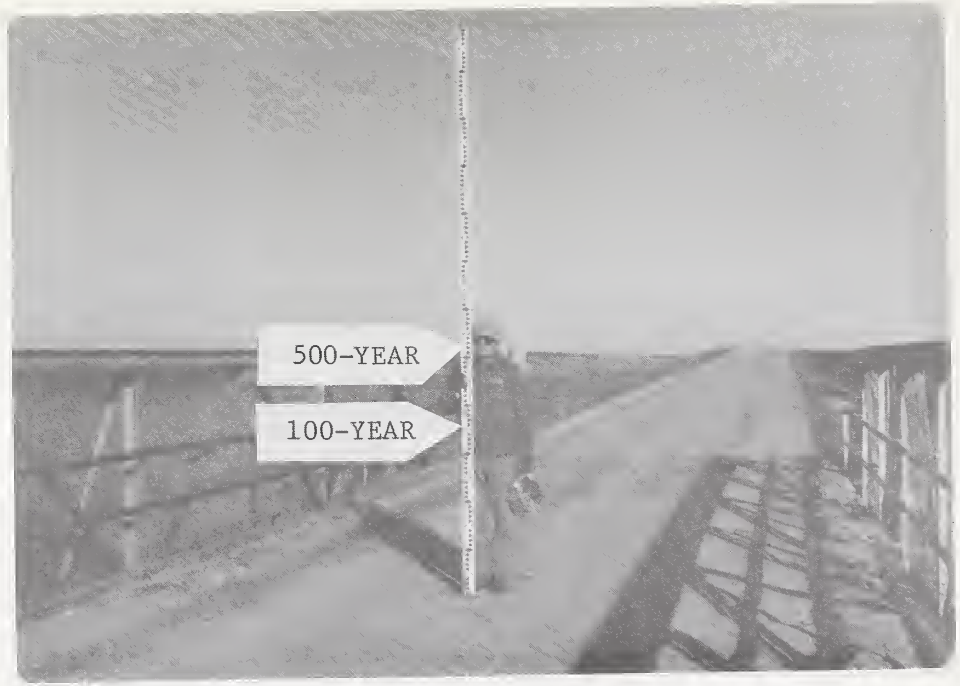

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Figure 23 - M 17.92 Sections 3 and 4, T. 132 N., R. 49 W.

Figure 24 - M 19.54 Sections 4 and 5, T. 132 N., R. 49 W.

Figure 25 - M 21.78 Sections 5 and 6, T. 132 N., R. 49 W.

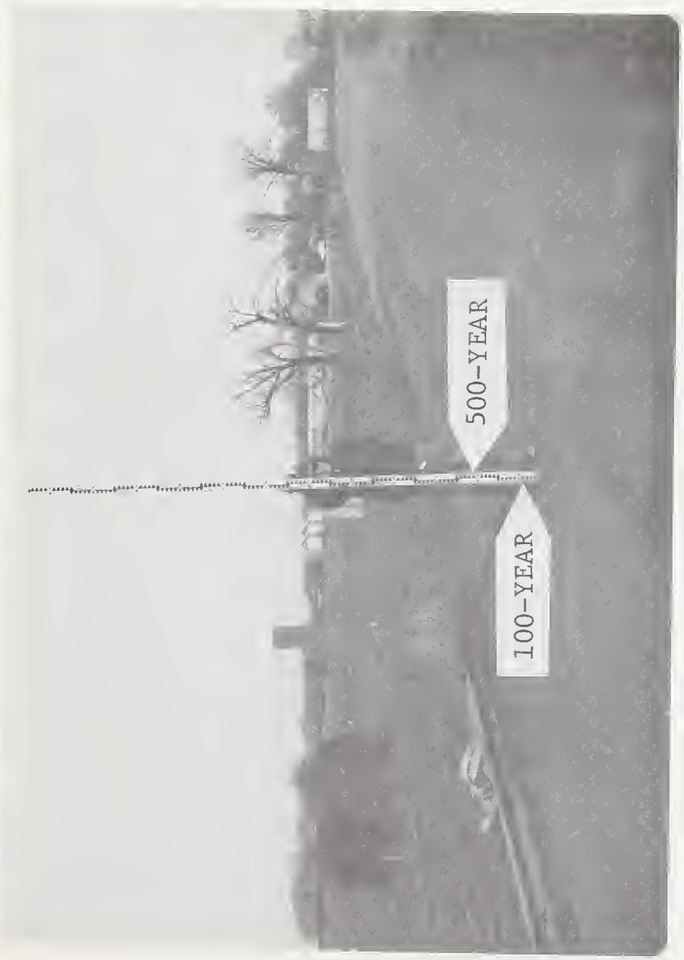

Figure 26 - M 22.81 County Highway North of Mooreton

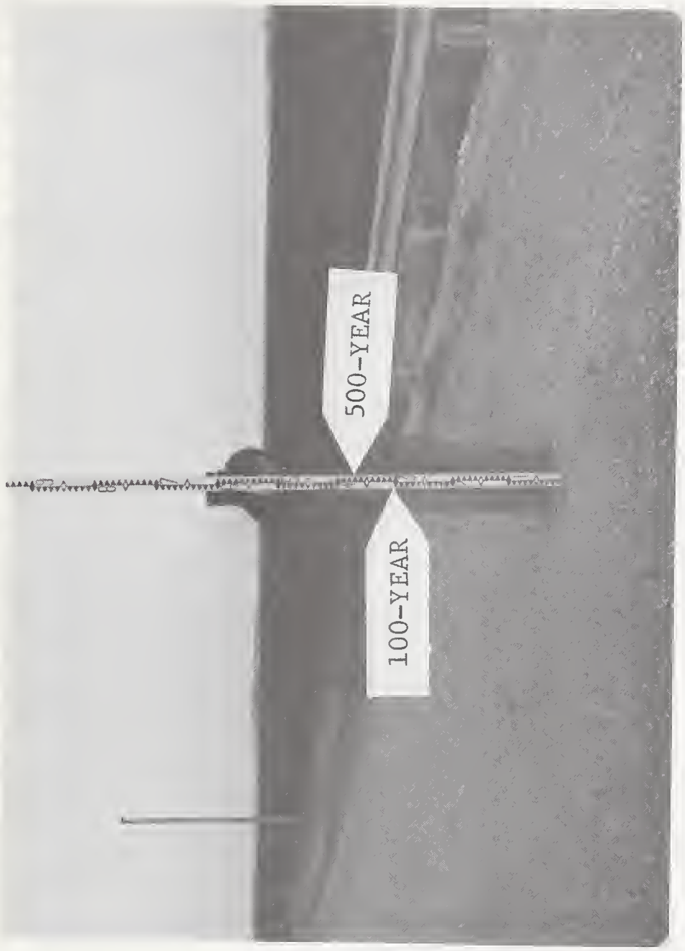

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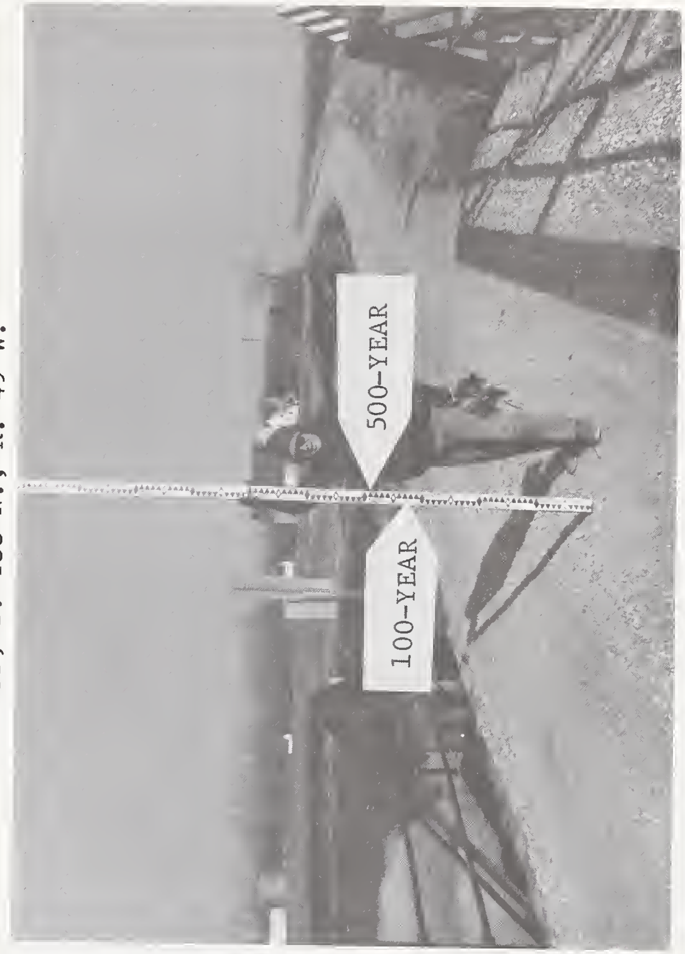
Figure 28 - M 26.07 Sections 30 and 31, T. 133 N., R. 49 W.



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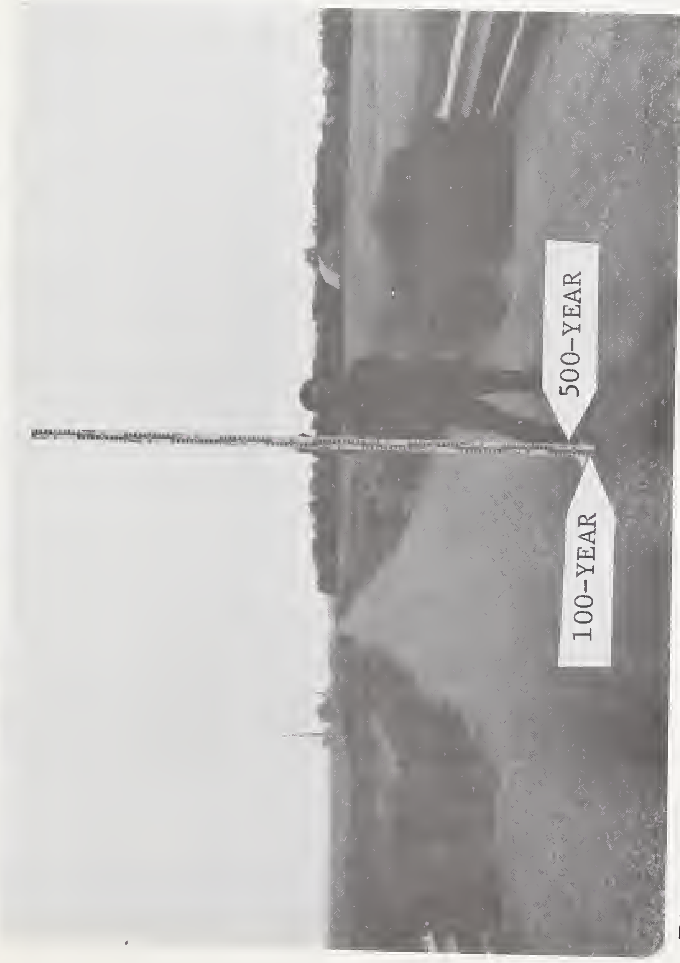

Figure 30 - M 28.38 Sections 24 and 25, T. 133 N., R. 50 W.

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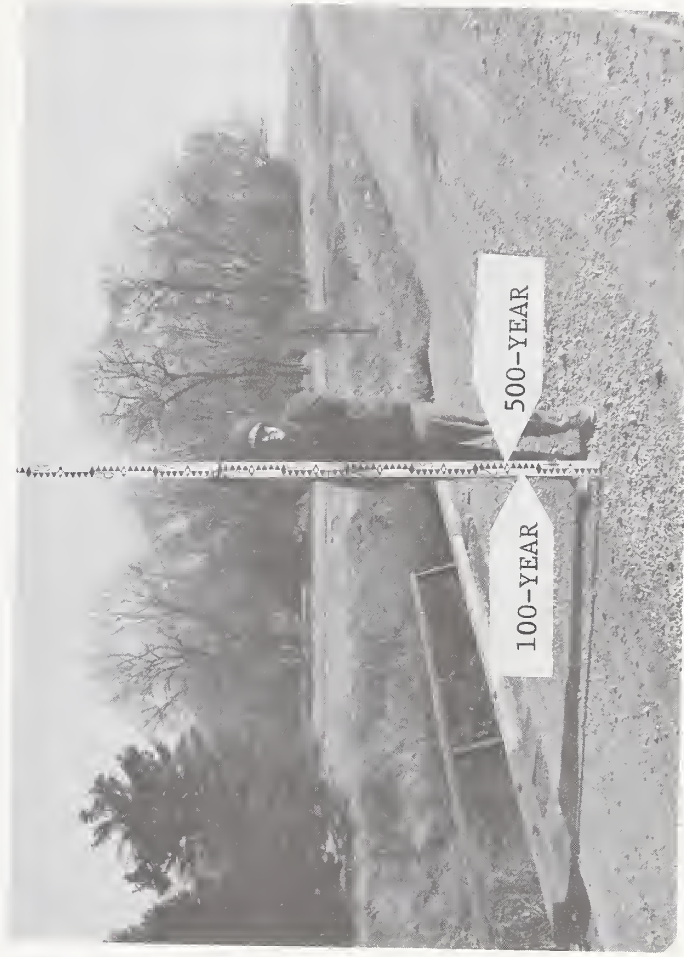

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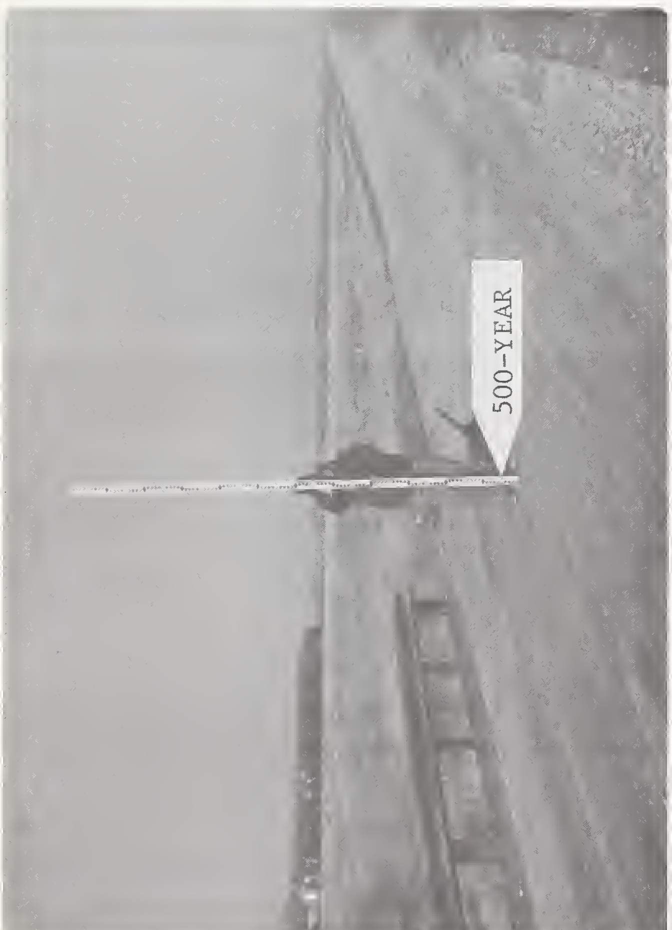

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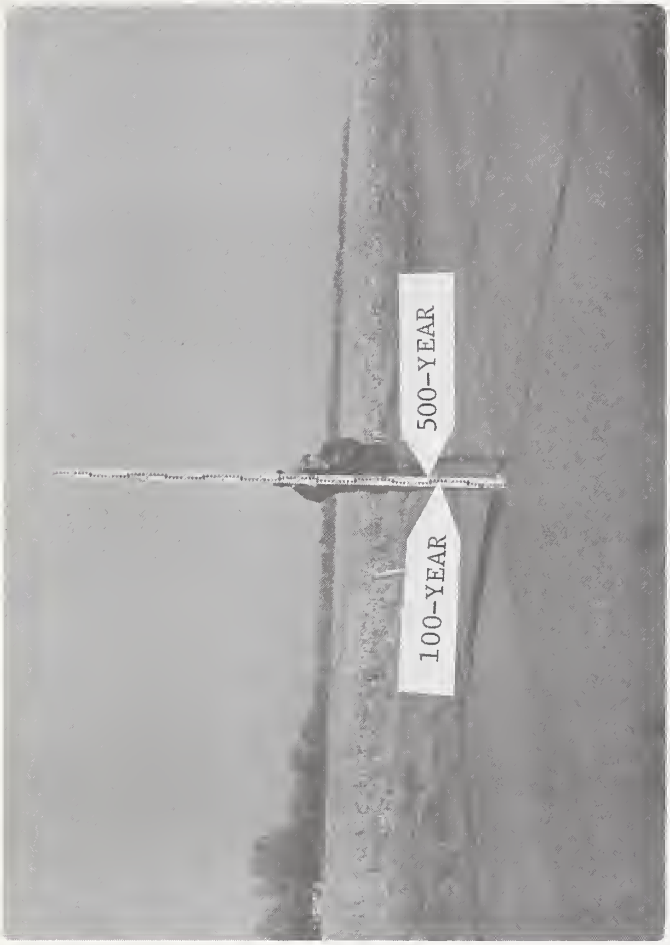

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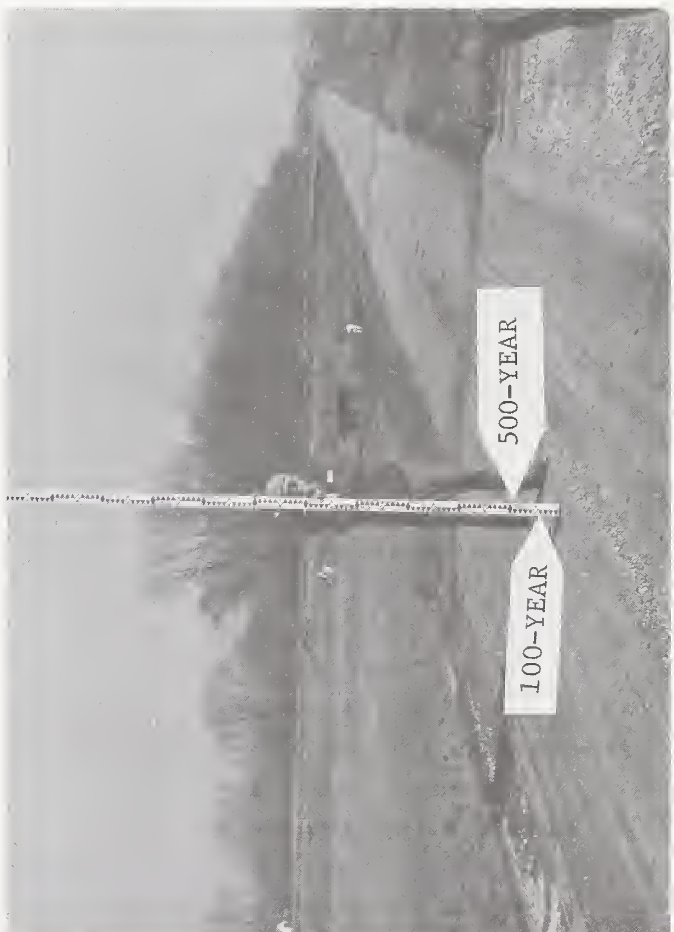

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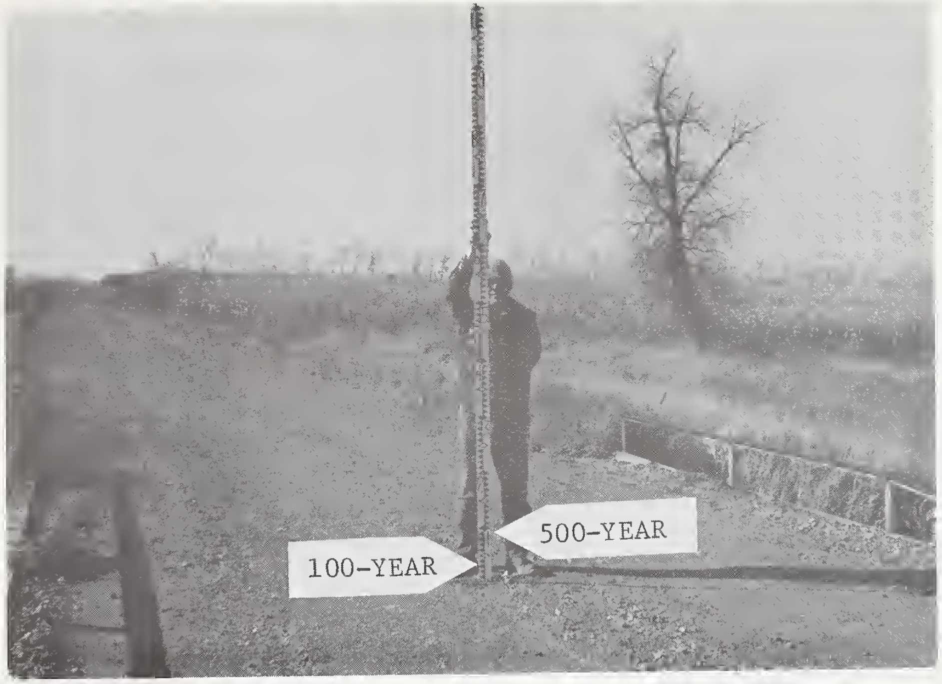

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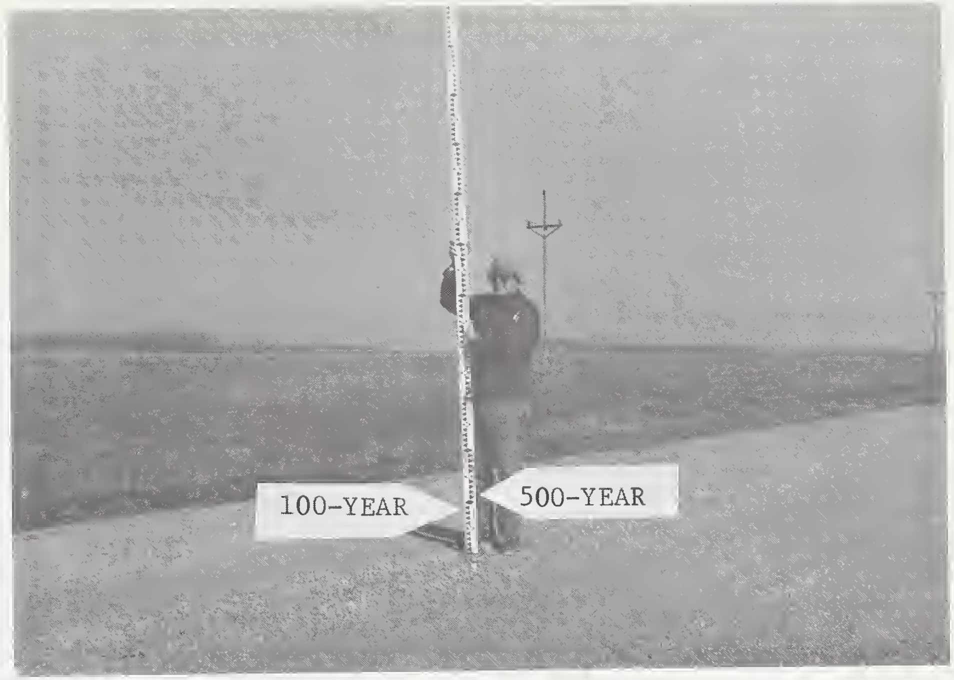
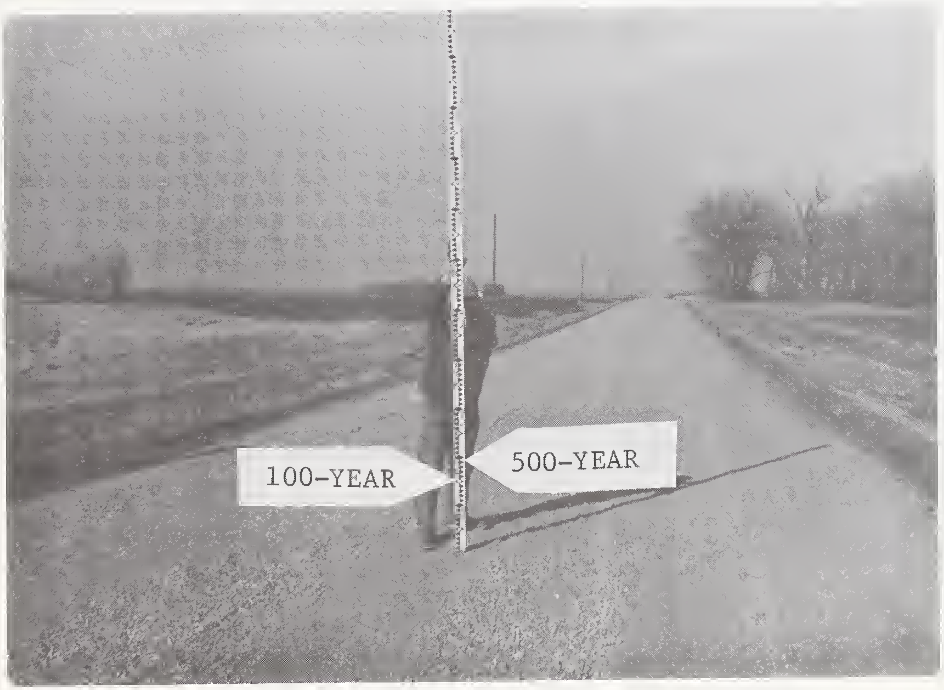


Figure 39 - M 44.76 Sections 8 and 17, T. 134 N., R. 50 W.



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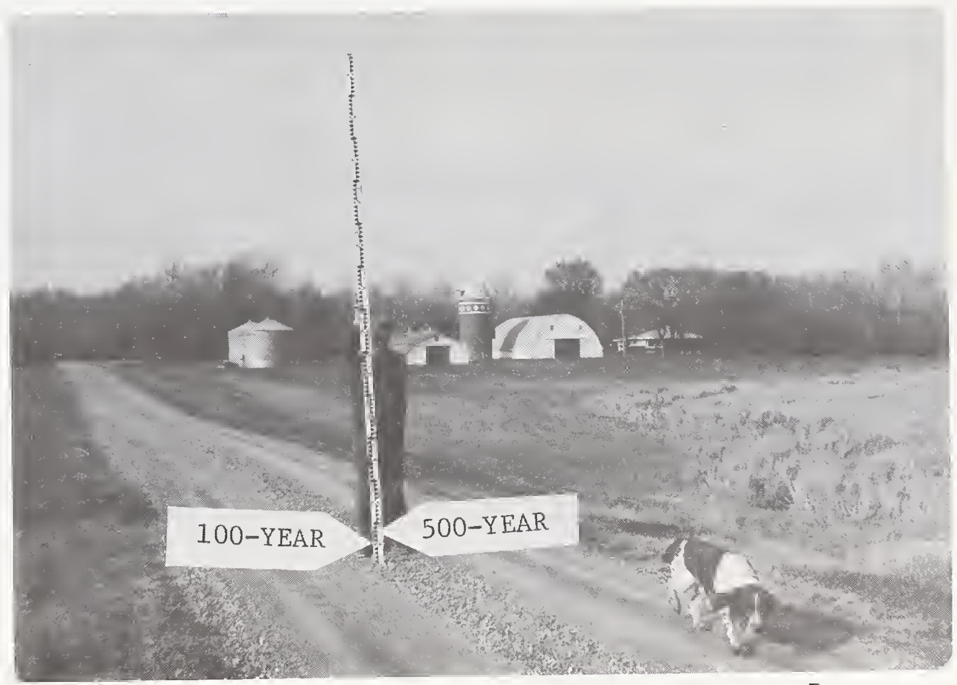
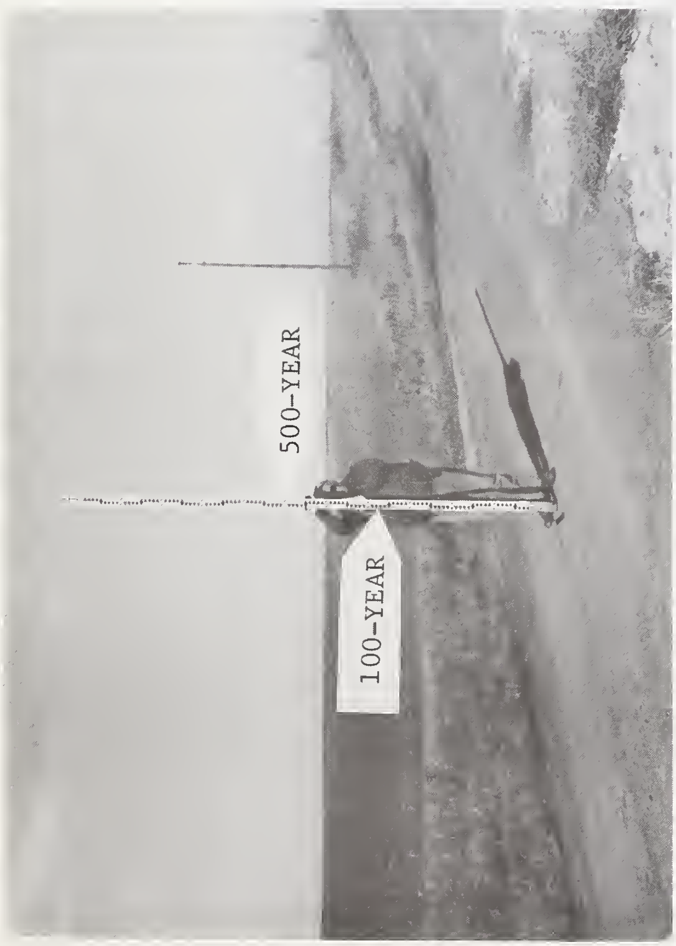


Figure 41 - M 45.42 Private Driveway in Section 7, T. 134 N., R. 50 W.



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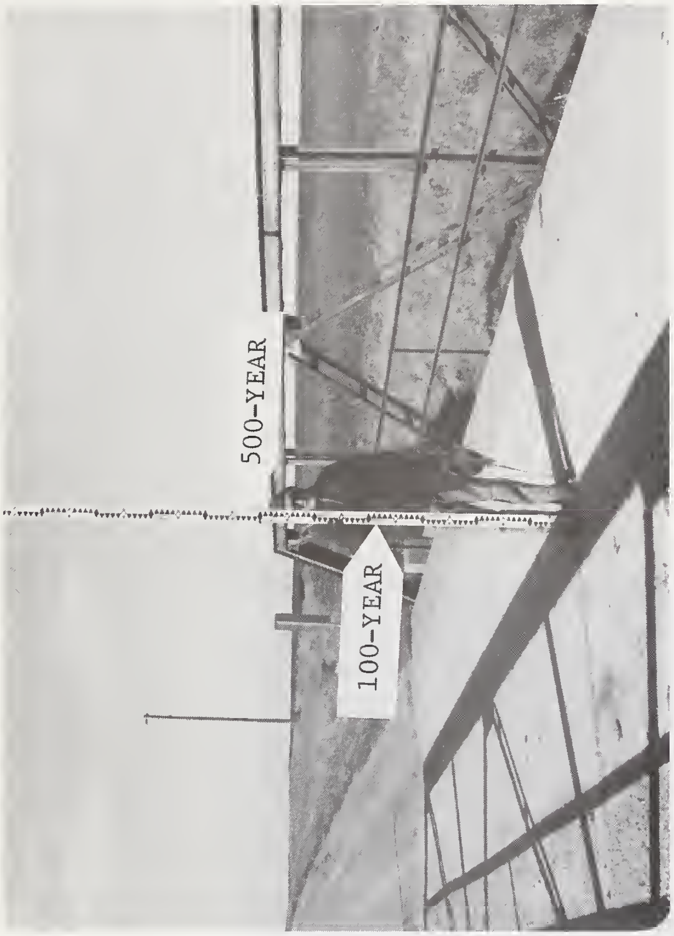

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Figure 44 - M 4.18 Sections 10 and 11, T. 132 N., R. 49 W.

Figure 45 - M 4.99 Private Driveway in Section 15, T. 132 N., R. 49 W.

Figure 46 - M 11.98 Sections 19 and 20, T. 132 N., R. 49 W.

APPENDIX A

SOILS

The soil information in this report is for only the flood plain area. The soils of Richland County are mapped, described, and interpreted in greater detail in the "Soil Survey of Richland County and National Grassland Area of Ransom County, North Dakota." Copies of this survey and help in using soil information are available from the local Soil Conservation Service Office in Richland County.

Interpretations are given in Table I for a number of uses.

Yield Per Acre

The average yields per acre that can be expected of spring wheat under a high level of management are shown in the table. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; proper planting and seeding rates; use of suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and timely harvesting that insures highest profits. Dashes indicated crops not grown or not suited to the soil.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally

expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, woodland or engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or require special conservation practices or both.

Class III soils have severe limitations that reduce the choice of plants or require special conservation practices or both.

Class IV soils have very severe limitations that reduce the choice of plants or require very careful management or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils have limitations that essentially preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, e, w, s, or c, to the class numeral, for example, IIe.

The letter e shows that the main limitation is risk of erosion unless closegrowing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage)/ s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that if very cold or very dry.

In Class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w, s or c because the soils in Class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat or recreation.

Important Farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the nation's short and long-range needs for food and fiber. Prime farmland is the land best suited to producing food, feed, forage, fiber and oilseed crops. Prime farmland may be in pasture, crops, woodland or other land but is is not urban or built up land or water areas.

Soil Uses and Limitations

The soils are rated in Table I according to limitations that affect their suitability for playgrounds, picnic areas, dwellings with basements, septic tank absorption fields, sewage lagoons, fill materials for embankments and topsoil. The ratings are based on restrictive soil features such as

wetness, slope and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, is the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreations use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, on site assessment of the height, duration, intensity and frequency of flooding is essential.

The degree of soil limitation is expressed as slight, moderate or severe. Slight means that soil properties are generally favorable and that limitations can be overcome or alleviated by planning, design or special maintenance. Severe means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use or by a combination of these measures.

Dwellings

Ratings are made for small dwellings with basements on undisturbed soil. The ratings are based on soil properties, site features and observed performance of the soils. A high water table, flooding, shrink-swell potential and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Septic Tank Absorption Fields

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe.

Only that part of the soil between depths of 24 to 72 inches is evaluated. The ratings are based on soils properties, site features and observed performance of the soils. Permeability, a high water table, depth to bedrock or a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock, or a cemented pan interfere with installation.

Playgrounds

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Picnic Areas

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use and do not have slopes, stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Sewage Lagoons

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

The table gives ratings for the natural soil that makes up the lagoon floor. The surface layer and generally 1 to 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock and cemented pans can cause construction problems and large stones can hinder compaction of the lagoon floor.

Embankment, Dikes, and Levees

Embankment, dikes and levees are raised structures of soil material constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of fill material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping and erosion, and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or

boulders, organic matter, salts or sodium. A high water table affects the amount of usable material.

Topsoil

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity and fertility. The ease of excavating, loading and spreading is affected by rock fragments, slope, water table, soil texture and thickness of suitable material. Reclamation of the borrow area is affected by slope, water table, rock fragments, bedrock and toxic material.

Soils rated good have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer and are not so wet that excavation is difficult.

Soils rated fair are sandy soils; loamy soils that have a relatively high content of clay; soils that have only 20 to 40 inches of suitable material; soils that have an appreciable amount of gravel, stones, or soluble salts; or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated poor are very sandy or clayey; have less than 20 inches of suitable material; have a large amount of gravel, stones or soluble salts; have slopes of more than 15 percent; or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

ANTELOPE CREEK FLOOD PLAIN MANAGEMENT STUDY

RICHLAND COUNTY, NORTH DAKOTA

TABLE I: SOIL INTERPRETATIONS FOR SELECTED USES

Soil Symbol	Soil Name	Capability Class and Subclass	Important Farmland Category 1/	Spring Wheat Yield Bu/Ac 2/	Dwellings With Basements 3/	Septic Tank Absorption Fields 3/	Playgrounds	Picnic Areas	Sewage Lagoons 3/	Dikes, Levees, Embankments	Topsoil
Ah	Aberdeen silt loam	3s	AFSI	38	Severe - Shrink-Swell	Severe - Percs Slowly	Severe - Excess Sodium	Severe - Excess Sodium	Moderate - Seepage, Wetness	Severe - Piping, Excess Sodium	Poor - Excess Sodium
Ak	Aberdeen - Galchutt silty clay loams	3s	AFLI	40	Severe - Shrink-Swell	Severe - Percs Slowly	Severe - Excess Sodium, Wetness	Severe - Excess Sodium	Moderate - Seepage, Wetness	Severe - Piping, Excess Sodium, hard to pack	Poor - Excess Sodium-Aberdeen Fair - Thin Layer-Galchutt
Ao	Aberdeen-Ryan silty clay loams	3s	AFLI	32	Severe - Wetness, Shrink-Swell	Severe - Percs Slowly, Wetness	Severe - Excess Sodium, Wetness	Severe - Excess Sodium, Wetness	Severe - Wetness	Severe - Piping, Excess Sodium, Wetness	Poor - Excess Sodium
At	Arveson-Fossum fine sandy loams	3we	AFLI	24	Severe - Wetness	Severe - Wetness, Poor Filter	Severe - Wetness	Moderate - Wetness	Severe - Seepage, Wetness	Severe - Seepage, Piping, Wetness	Fair - Thin Layer-Arveson Poor - Thin Layer-Fossum
Au	Arveson and Fossum loams	2w	AFLI	24	Severe - Wetness	Severe - Wetness, Poor Filter	Severe - Wetness	Moderate - Wetness	Severe - Seepage, Wetness	Severe - Seepage, Piping, Wetness	Fair - Thin Layer-Arveson Poor - Thin Layer-Fossum
Av	Arveson and Fossum loams, very wet	5w	0	0	Severe - Wetness, Ponding	Severe - Wetness, Poor Filter, Ponding	Severe - Ponding	Severe - Ponding	Severe - Seepage, Wetness	Severe - Seepage, Piping, Wetness	Fair - Thin Layer-Arveson Poor - Thin Layer-Fossum
Bf	Bearden silty clay loam	2e	P	43	Severe - Wetness	Severe - Wetness, Percs Slowly	Moderate - Wetness	Moderate - Percs Slowly, Wetness	Severe - Wetness	Moderate - Piping, Hard to Pack, Wetness	Fair - Too Clayey
Bg	Bearden and Glyndon silt loams,	2e	P	33	Severe - Wetness	Severe - Wetness, Percs Slowly	Moderate - Wetness	Moderate - Percs Slowly, Wetness	Severe - Seepage, Wetness	Severe - Piping, Hard to Pack, Wetness	Fair - Thin Layer
Bo	Borup loam	2w	P(wd)	33	Severe - Wetness	Severe - Wetness	Severe - Wetness	Moderate - Wetness	Severe - Seepage, Wetness	Severe - Piping, Wetness	Fair - Thin Layer
EeC	Eckman - Zell silt loams, rolling	3e	AFLI	27	Slight	Slight	Severe - Slope	Slight	Severe - Slope	Severe - Piping	Good
EmB	Egeland and Maddock fine sandy loams, undulating	3e	AFSI	21	Slight	Severe - Poor Filter	Slight	Slight	Severe - Seepage	Severe - Piping, Seepage	Good - Egeland Poor - Thin Layer-Maddock
En	Embden - Tiffany fine sandy loams	3e	P(wd)	35	Severe - Wetness	Severe - Wetness	Slight - Embden Severe - Wetness, Tiffany	Slight - Embden Severe - Wetness - Tiffany	Severe - Seepage, Ponding	Severe - Piping, Seepage, Ponding	Good - Embden Poor - Wetness-Tiffany
Et	Embden - Tiffany loams	2e	P(wd)	35	Severe - Wetness	Severe - Wetness	Slight - Embden Severe - Wetness, Tiffany	Slight - Embden Severe - Wetness - Tiffany	Severe - Seepage, Ponding	Severe - Piping, Seepage, Ponding	Good - Embden Poor - Wetness-Tiffany

TABLE I: continued

Soil Symbol	Soil Name	Capability Class and Subclass	Important Farmland Category 1/	Spring Wheat Yield Bu/Ac 2/	Dwellings With Basements 3/	Septic Tank Absorption Fields 3/	Playgrounds	Picnic Areas	Sewage Lagoons 3/	Dikes, Levees, Embankments	Topsoil
Ey	Exline and Ryan soils	6s	0	0	Severe - Wetness, Shrink-Swell	Severe - Peres Slowly, Wetness	Severe - Excess Sodium, Wetness	Severe - Wetness, Excess Sodium	Severe - Wetness	Severe - Excess Sodium, Piping, Wetness	Poor - Excess Sodium, Too Clayey, Wetness
Fe	Fargo silty clay loam	2w	P(wd)	44	Severe - Wetness, Shrink-Swell	Severe - Percs Slowly, Wetness	Severe - Wetness	Severe - Wetness	Slight	Severe - Hard to Pack, Wetness	Poor - Wetness
Ff	Fargo silty clay	2we	P(wd)	44	Severe - Wetness, Shrink-Swell	Severe - Percs Slowly, Wetness	Severe - Wetness, Too Clayey	Severe - Wetness, Too Clayey	Slight	Severe - Hard to Pack, Wetness	Poor - Wetness, Too Clayey
Fg	Fargo silty clay, depressional	2we	P(wd)	44	Severe - Ponding, Wetness, Shrink-Swell	Severe - Percs Slowly, Ponding	Severe - Ponding, Too Clayey	Severe - Ponding, Too Clayey	Severe - Ponding	Severe - Hard to Pack, Ponding	Poor - Wetness, Too Clayey
FhB	Fargo silty clay, gently sloping	2e	P(wd)	40	Severe - Wetness, Shrink-Swell	Severe - Percs Slowly, Wetness	Severe - Wetness, Too Clayey	Severe - Wetness, Too Clayey	Slight	Severe - Hard to Pack, Wetness	Poor - Wetness, Too Clayey
Fm	Fargo-Enloe silty clay loams	2w	P(wd)	40	Severe - Wetness, Shrink-Swell	Severe - Percs Slowly, Wetness	Severe - Wetness, Ponding	Severe - Wetness, Ponding	Slight - Fargo Severe - Ponding - Enloe	Severe - Hard to Pack, Ponding	Poor - Wetness
Fs	Fargo-Ryan silty clays	3s	AFLI	33	Severe - Wetness, Shrink-Swell	Severe - Percs Slowly, Wetness	Severe - Wetness, Too Clayey, Excess Sodium	Severe - Too Clayey, Wetness	Slight - Fargo Severe - Wetness - Ryan	Severe - Wetness, Excess Sodium, Hard to Pack	Poor - Wetness, Too Clayey
Ga	Galchutt silt loam	2w	P(wd)	43	Severe - Wetness, Shrink-Swell	Severe - Percs Slowly, Wetness	Severe - Wetness	Severe - Wetness	Slight	Severe - Hard to Pack	Fair - Thin Layer
Gc	Galchutt-Enloe-Fargo complex	2w	P(wd)	40	Severe - Wetness, Shring-Swell	Severe - Percs Slowly Wetness	Severe - Wetness, Ponding	Severe - Wetness, Ponding	Slight - Fargo & Galchutt Severe - Ponding - Enloe	Severe - Hard to Pack, Wetness, Ponding	Fair - Thin Layer-Galchutt Poor - Wetness-Enloe and Fargo
Gd	Galchutt-Overly silt loams	2c	P(wd)	43	Severe - Wetness, Shrink-Swell	Severe - Percs Slowly, Wetness	Severe - Wetness - Galchutt Slight - Overly	Severe - Wetness - Galchutt Slight - Overly	Slight	Severe - Hard to Pack, Piping	Fair - Thin Layer-Galchutt Good - Overly
Ge	Gardena silt loam	2e	P	45	Moderate - Wetness	Moderate - Wetness	Slight	Slight	Moderate - Wetness, Seepage	Severe - Piping,	Good
GfB	Gardena-Eckman silt loams, Undulating	2e	P	41	Moderate - Wetness	Moderate - Wetness	Moderate - Slope	Slight	Moderate - Wetness, Seepage	Severe - Piping, Seepage	Good
Gh	Gardena and Embden loams	2e	P	38	Moderate - Wetness	Moderate - Wetness	Slight	Slight	Moderate - Wetness, Seepage	Severe - Piping, Seepage	Good
Go	Glyndon silt loam	2e	P	43	Severe - Wetness	Severe - Wetness	Slight	Slight	Severe - Seepage, Wetness	Severe - Piping	Fair - Thin Layer

TABLE I: continued

Soil Symbol	Soil Name	Capability Class and Subclass	Important Farmland Category [1/]	Spring Wheat Yield Bu/Ac [2/]	Dwellings With Basements [3/]	Septic Tank Absorption Fields [3/]	Playgrounds	Picnic Areas	Sewage Lagoons [3/]	Dikes, Levees, Embankments	Topsoil
Gr	Glyndon-Tiffany very fine sandy loams	2e	P(Wd)	36	Severe - Wetness	Severe - Wetness	Slight - Glyndon Severe - Ponding - Tiffany	Slight - Glyndon Severe - Ponding - Tiffany	Severe - Seepage, Wetness	Severe - Piping, Ponding	Fair - Thin Layer-Glyndon Poor - Wetness-Tiffany
Gu	Glyndon and Wyndmere loams	2e	P	33	Severe - Wetness	Severe - Wetness	Slight - Glyndon Moderate - Wetness-Wyndmere	Slight - Glyndon Moderate - Wetness - Wyndmere	Severe - Seepage, Wetness	Severe - Piping	Fair - Thin Layer
Hm	Hecla-Hamar loamy fine sands	4e	AFLI	24	Severe - Wetness	Severe - Wetness, Poor Filter	Slight - Hecla Severe - Wetness - Hamar	Slight - Hecla Severe - Wetness - Hamar	Severe - Seepage, Wetness	Severe - Seepage, Piping, Wetness	Poor - Thin Layer-Hecla Poor - Wetness-Hamar
Hn	Hecla-Hamar fine sandy loams	3e	AFLI	29	Severe - Wetness	Severe - Wetness, Poor Filter	Slight - Hecla Severe - Wetness - Hamar	Slight - Hecla Severe - Wetness - Hamar	Severe - Seepage, Wetness	Severe - Seepage, Piping, Wetness	Poor - Thin Layer-Hecla Poor - Wetness-Hamar
La	LaDelle silty clay loam	2c	P	45	Severe - Flooding	Severe - Flooding	Moderate - Flooding	Slight	Severe - Flooding	Severe - Hard to Pack	Good
Lb	LaDelle and Wahpeton soils, Channeled	6e	0	0	Severe - Flooding	Severe - Flooding	Moderate - Flooding	Slight	Severe - Flooding	Severe - Hard to Pack	Good
Lp	LaPrairie silt loam	2c	P	45	Severe - Flooding	Severe - Flooding	Moderate - Flooding	Slight	Severe - Flooding	Moderate - Piping, Wetness	Good
NuC	Nutley silty clay, rolling	3e	AFSI	29	Severe - Shrink-Swell	Severe - Percs Slowly	Severe - Slope	Moderate - Slope, Too Clayey	Severe - Slope	Moderate - Hard to Pack	Poor - Too Clayey
Oc	Overly silty clay loam	2c	P	45	Moderate - Shrink-Swell	Severe - Percs Slowly	Slight	Slight	Slight	Severe - Piping	Fair - Too Clayey
Od	Overly-Bearden silt loams, moderately saline	3s	AFLI	22	Moderate - Shrink-Swell	Severe - Percs Slowly, Wetness	Moderate - Wetness	Moderate - Wetness, Percs Slowly	Slight - Overly Severe - Wetness - Bearden	Severe - Piping	Poor - Excess Salts
OlB	Overly-Beotia silty clay loams, undulating	2e	P	43	Moderate - Shrink-Swell	Severe - Percs Slowly	Slight	Slight	Slight	Severe - Piping	Fair - Too Clayey
Ps	Perella silty clay loam, moderately deep over clay	2w	P(wd)	35	Severe - Wetness	Severe - Percs Slowly	Severe - Ponding	Severe - Ponding	Severe - Ponding	Severe - Piping, Ponding	Poor - Wetness
Ry	Ryan-Fargo complex	3s	AFLI	28	Severe - Wetness, Shrink-Swell	Severe - Percs Slowly, Wetness	Severe - Excess Sodium, Wetness	Severe - Excess Sodium, Wetness	Severe - Wetness	Severe - Excess Sodium, Wetness, Piping	Poor - Wetness, Too Clayey, Excess Sodium
Td	Tiffany fine sandy loam	3we	P(wd)	24	Severe - Wetness	Severe - Wetness	Severe - Ponding	Severe - Ponding	Severe - Seepage, Ponding	Severe - Piping, Ponding	Poor - Wetness

Soil Symbol	Soil Name	Capability Class and Subclass	Important Farmland Category 1/	Spring Wheat Yield Bu/Ac 2/	Dwellings With Basements 3/	Septic Tank Absorption Fields 3/	Playgrounds	Picnic Areas	Sewage Lagoons 3/	Dikes, Levees, Embankments	Topsoil
Tf	Tiffany Loam	2w	P(wd)	33	Severe - Wetness	Severe - Wetness	Severe - Ponding	Severe - Pending	Severe - Seepage, Pending	Severe - Piping, Ponding	Poor - Wetness
Th	Tiffany loam, moderately deep over clay	2w	P(wd)	33	Severe - Wetness	Severe - Wetness, Percs Slowly	Severe - Ponding	Severe - Pending	Severe - Seepage, Pending	Severe - Piping, Ponding	Poor - Wetness
Tw	Towner and Swenoda fine sany loams	3e	AFSI	33	Moderate - Wetness, Shrink-Swell	Severe - Percs Slowly	Slight	Slight	Severe - Seepage, Wetness	Severe Piping	Poor - Thin Layer
Wa	Wahpeton silty clay	2s	P	43	Severe - Flooding	Severe - Flooding	Moderate - Too Clayey, Flooding	Moderate - Too Clayey	Severe - Fleeding	Severe - Hard to Pack	Poor - Too Clayey
Wy	Wyndmere fine sandy loam	3e	P	33	Severe - Wetness	Severe - Wetness, Poor Filter	Moderate - Wetness	Moderate - Wetness	Severe - Seepage, Wetness	Severe - Piping	Fair - Thin Layer

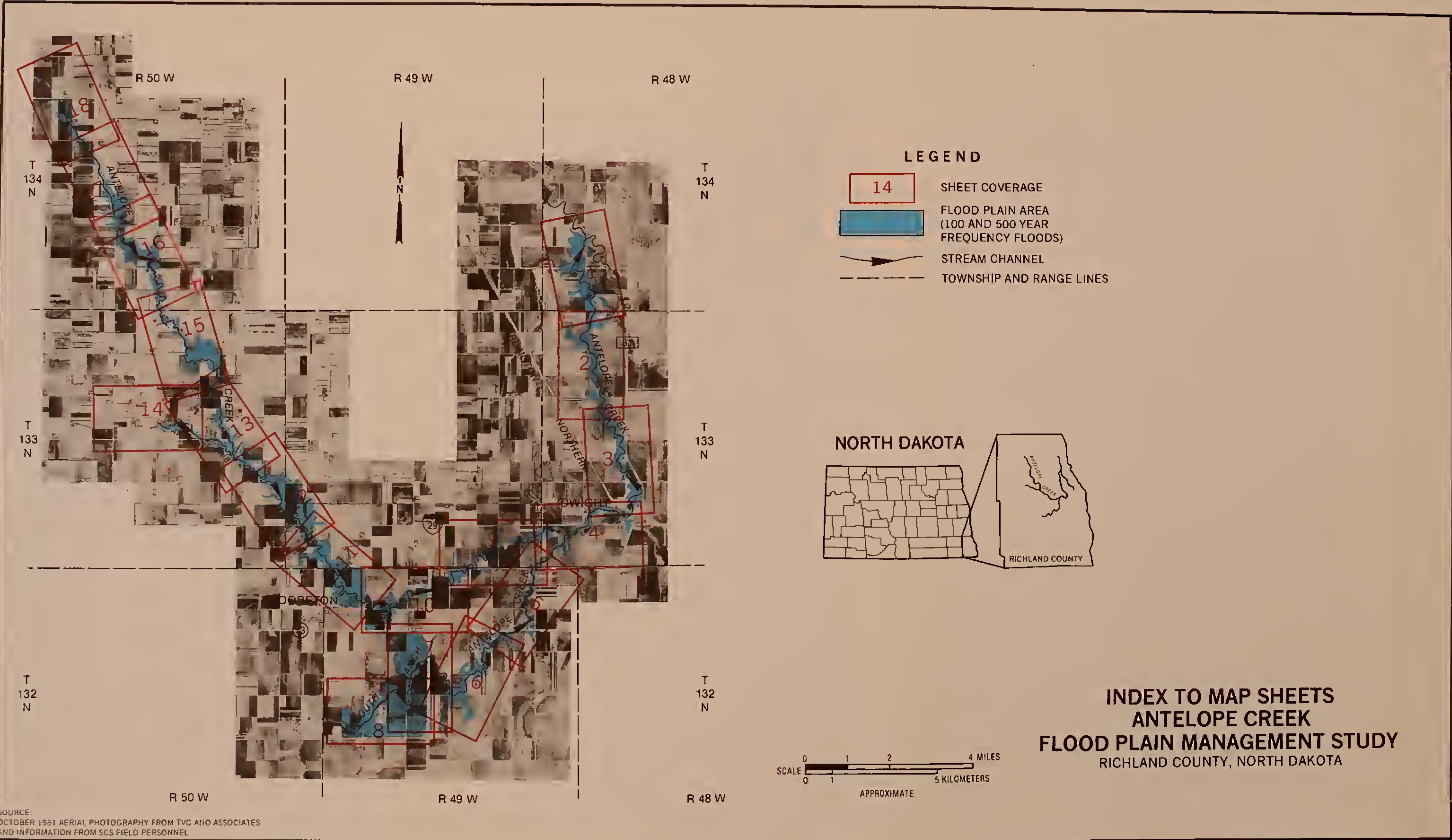
1/ P=prime, P(wd)=prime where drained, AFSI=additional farmlands of statewide importance, AFLI=additional farmlands of local importance, O=other land.

2/ All yields are for drained areas of the poorly drained and very poorly drained soils.

3/ Construction of dwellings, septic tanks and sewage lagoons is not recommended in the floodplain. However, if construction is necessary the developer should consider the flood hazard and soil restrictions presented in this report.

FLOOD HAZARD AREA PHOTOMAPS

APPENDIX B



INDEX TO MAP SHEETS
ANTELOPE CREEK
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

USDA-SCS-FORT WORTH, TEXAS 1984

LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)	M 12.93 VALLEY SECTION	FhB SOILS AREA & SYMBOLS	SCALE 0 800 1600 FEET
500 YEAR FREQUENCY FLOOD	~952~ ESTIMATED 100-YEAR FLOOD ELEVATION	RM 15 X REFERENCE MARK	0 200 400 METERS APPROXIMATE
STREAM CHANNEL			

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

ANTELOPE CREEK

SHEET 1 OF 18

JUNE 1984 4R-38528

LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 12.93 VALLEY SECTION

952 ESTIMATED 100-YEAR FLOOD ELEVATION

Wa SOILS AREA & SYMBOLS

RM 15 X REFERENCE MARK

SCALE 0 800 1600 FEET

0 200 400 METERS

APPROXIMATE

SHEET 2 OF 18

JUNE 1984 4R-38528

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

ANTELOPE CREEK

LEGEND

(light blue)	100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)	M 12.93	VALLEY SECTION	NuC	SOILS AREA & SYMBOLS
(dark blue)	500 YEAR FREQUENCY FLOOD	~952~	ESTIMATED 100-YEAR FLOOD ELEVATION	RM 15 X	REFERENCE MARK
	STREAM CHANNEL				

SCALE 0 — 800 — 1600 FEET
0 — 200 — 400 METERS
APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
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FLOOD HAZARD AREA

ANTELOPE CREEK

SHEET 3 OF 18

JUNE 1984 4R-38528

LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)	VALLEY SECTION (M 12.93)	SOILS AREA & SYMBOLS (EeC)	SCALE 0 — 800 — 1600 FEET; 0 — 200 — 400 METERS APPROXIMATE
500 YEAR FREQUENCY FLOOD	ESTIMATED 100-YEAR FLOOD ELEVATION (952)	REFERENCE MARK (RM 15 X)	
STREAM CHANNEL			

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

ANTELOPE CREEK AND SOUTH BRANCH ANTELOPE CREEK

SHEET 4 OF 18

JUNE 1983 4R-38528

LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)	M 12.93 VALLEY SECTION	NuC SOILS AREA & SYMBOLS
500 YEAR FREQUENCY FLOOD	~952~ ESTIMATED 100-YEAR FLOOD ELEVATION	RM 15 X REFERENCE MARK
STREAM CHANNEL		

SCALE 0 — 800 — 1600 FEET
0 — 200 — 400 METERS
APPROXIMATE

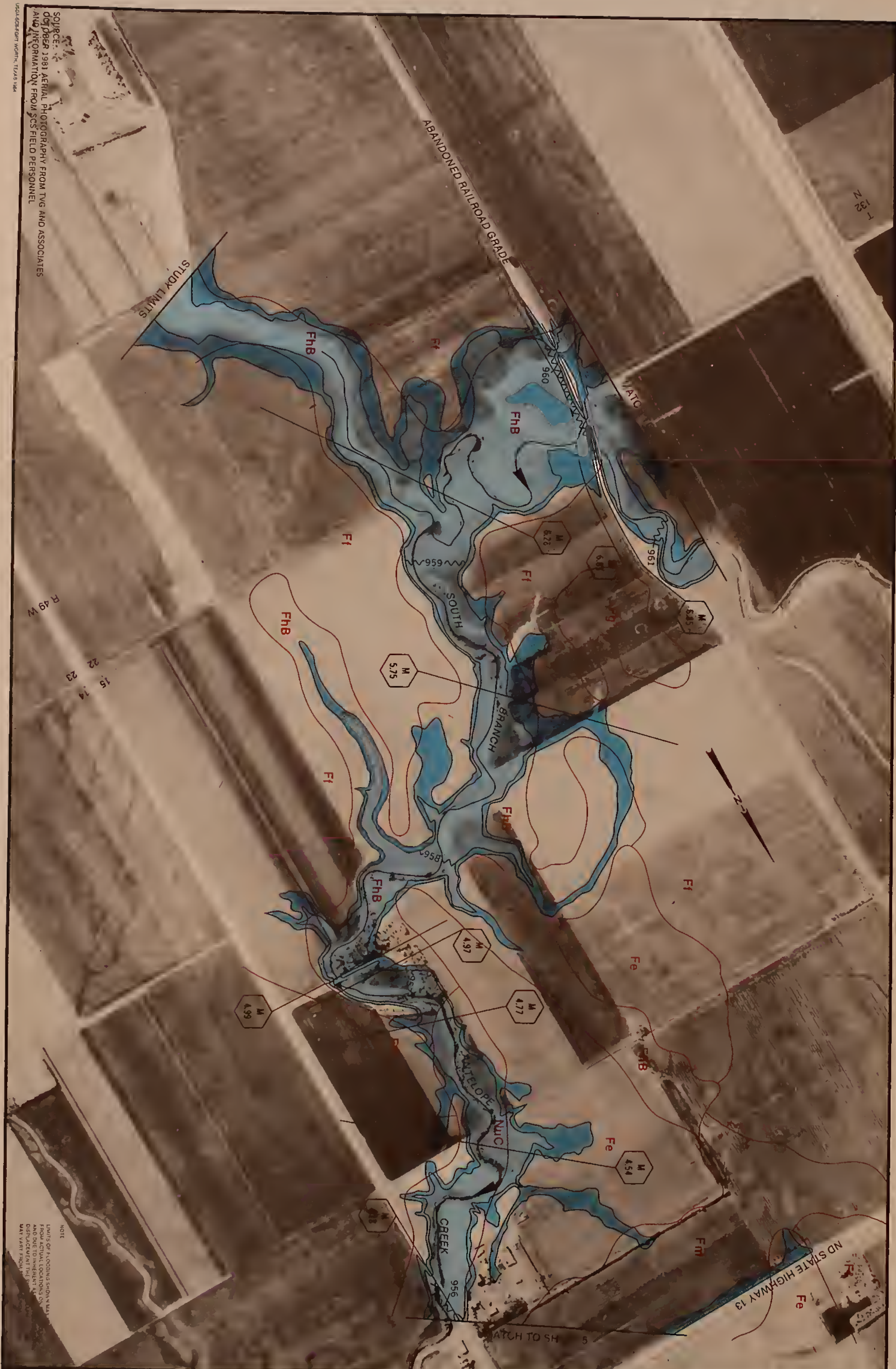
JUNE 1984 4R-38528

SHEET 5 OF 18

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

SOUTH BRANCH ANTELOPE CREEK



LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)	M 12.93 VALLEY SECTION
500 YEAR FREQUENCY FLOOD	952 ESTIMATED 100-YEAR FLOOD ELEVATION
STREAM CHANNEL	Fm SOILS AREA & SYMBOLS
	RM 15 X REFERENCE MARK

SCALE 0 800 1600 FEET
0 200 400 METERS
APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

SOUTH BRANCH ANTELOPE CREEK

SHEET 6 OF 18

JUNE 1984 4R-38528

LEGEND

	100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)	M 12.93	VALLEY SECTION	Gd	SOILS AREA & SYMBOLS
	500 YEAR FREQUENCY FLOOD	952	ESTIMATED 100-YEAR FLOOD ELEVATION	RM 15 X	REFERENCE MARK
	STREAM CHANNEL				

SCALE 0 — 800 — 1600 FEET
0 — 200 — 400 METERS
APPROXIMATE

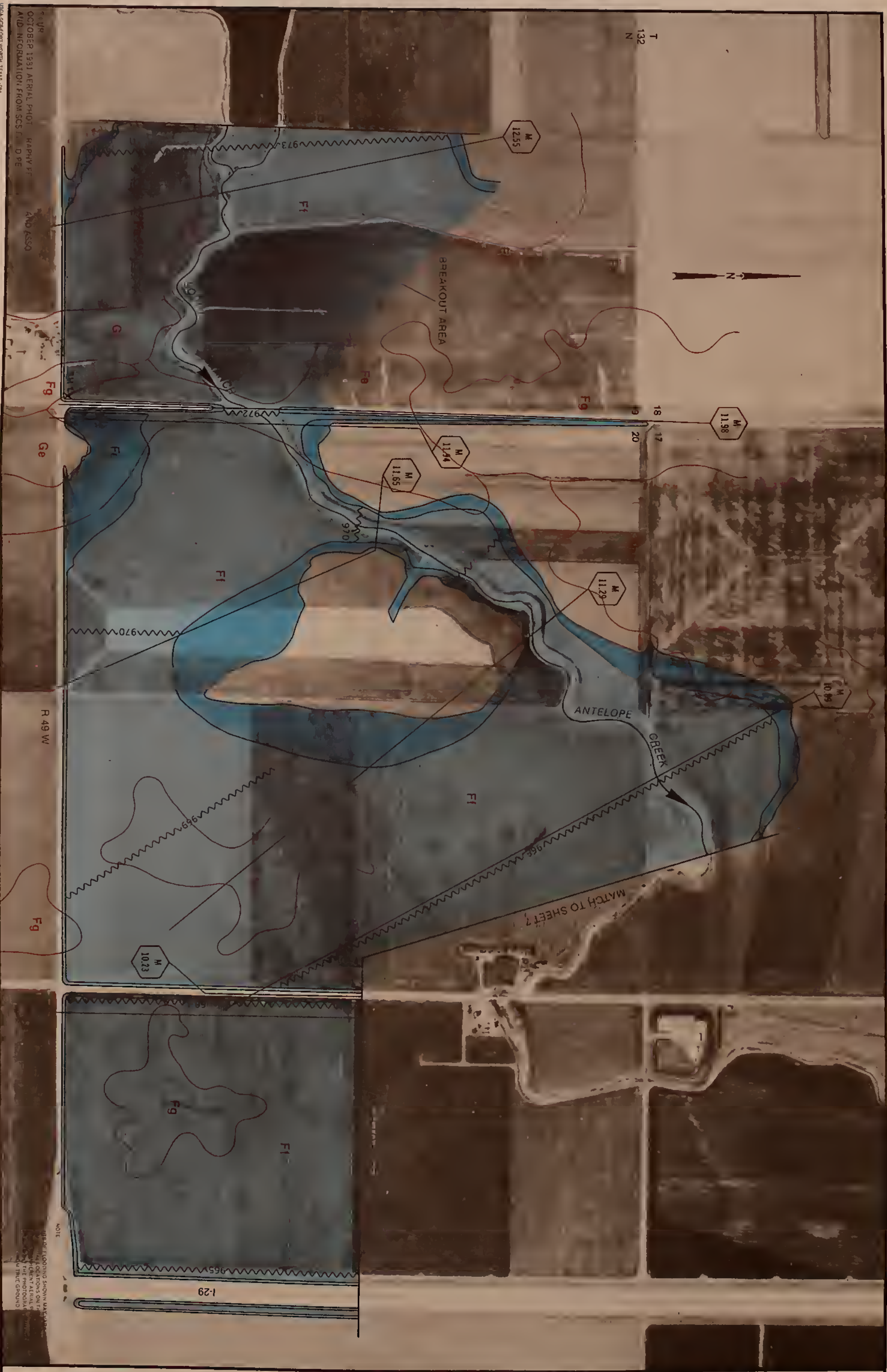
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

SOUTH BRANCH ANTELOPE CREEK

SHEET 7 OF 18

JUNE 1984 4R-39528



LEGEND

	100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)	M 12.93	VALLEY SECTION	Ah	SOILS AREA & SYMBOLS
	500 YEAR FREQUENCY FLOOD	~952~	ESTIMATED 100-YEAR FLOOD ELEVATION	RM 15 X	REFERENCE MARK
	STREAM CHANNEL				

SCALE 0 — 800 — 1600 FEET
0 — 200 — 400 METERS
APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

SOUTH BRANCH ANTELOPE CREEK

SHEET 8 OF 18

JUNE 1984 4R-38528

LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)	VALLEY SECTION (M 12.93)	SOILS AREA & SYMBOLS (Ps)
500 YEAR FREQUENCY FLOOD	ESTIMATED 100-YEAR FLOOD ELEVATION (952)	REFERENCE MARK (RM 15 X)
STREAM CHANNEL		

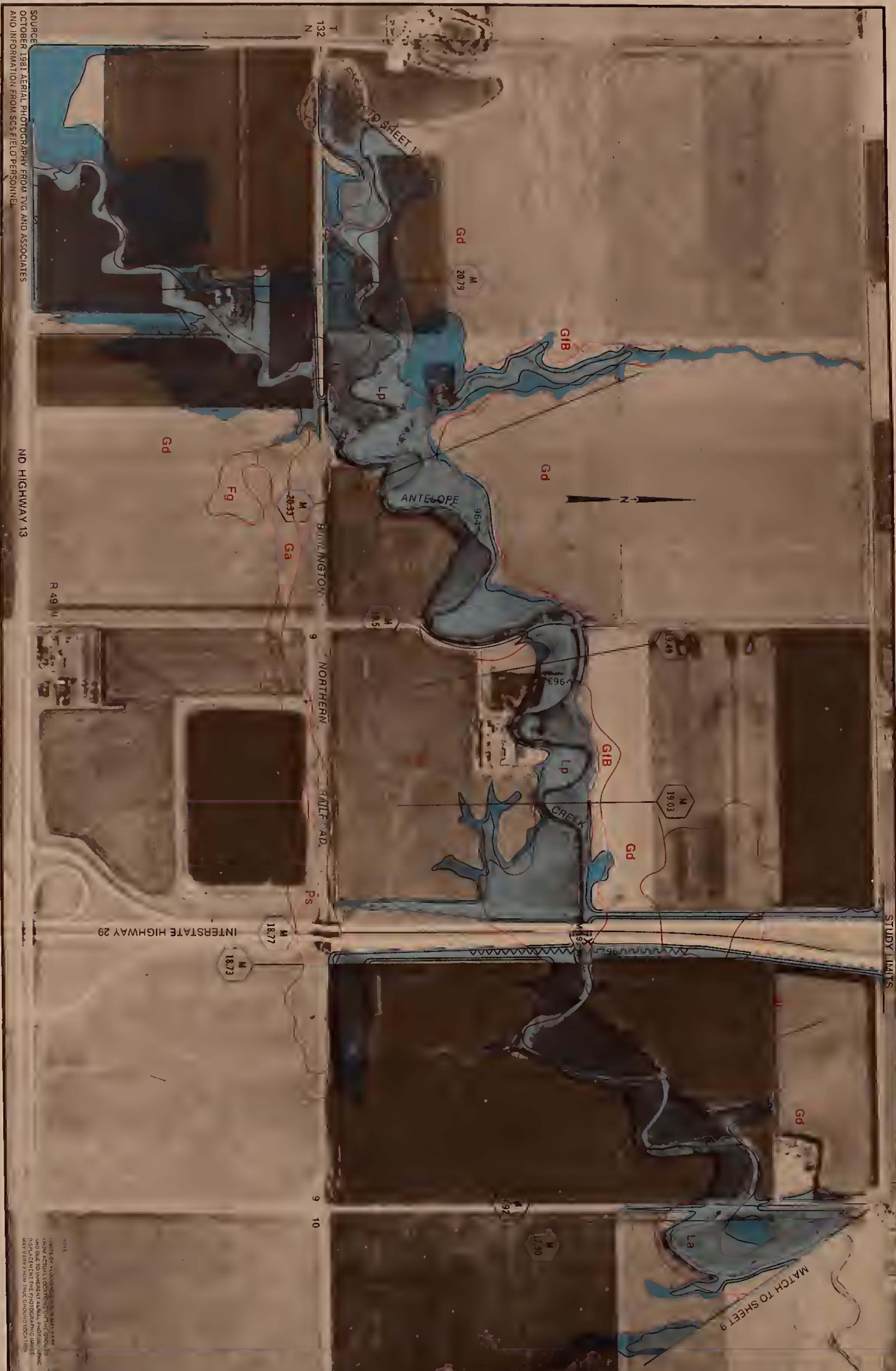
SCALE 0 — 800 — 1600 FEET
0 — 200 — 400 METERS
APPROXIMATE

SHEET 9 OF 18
JUNE 1984 4R-38526

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

ANTELOPE CREEK



LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 12,93 VALLEY SECTION

952 ESTIMATED 100-YEAR FLOOD ELEVATION

GfB SOILS AREA & SYMBOLS

RM 15 X REFERENCE MARK

SCALE 0 800 1600 FEET
0 200 400 METERS
APPROXIMATE

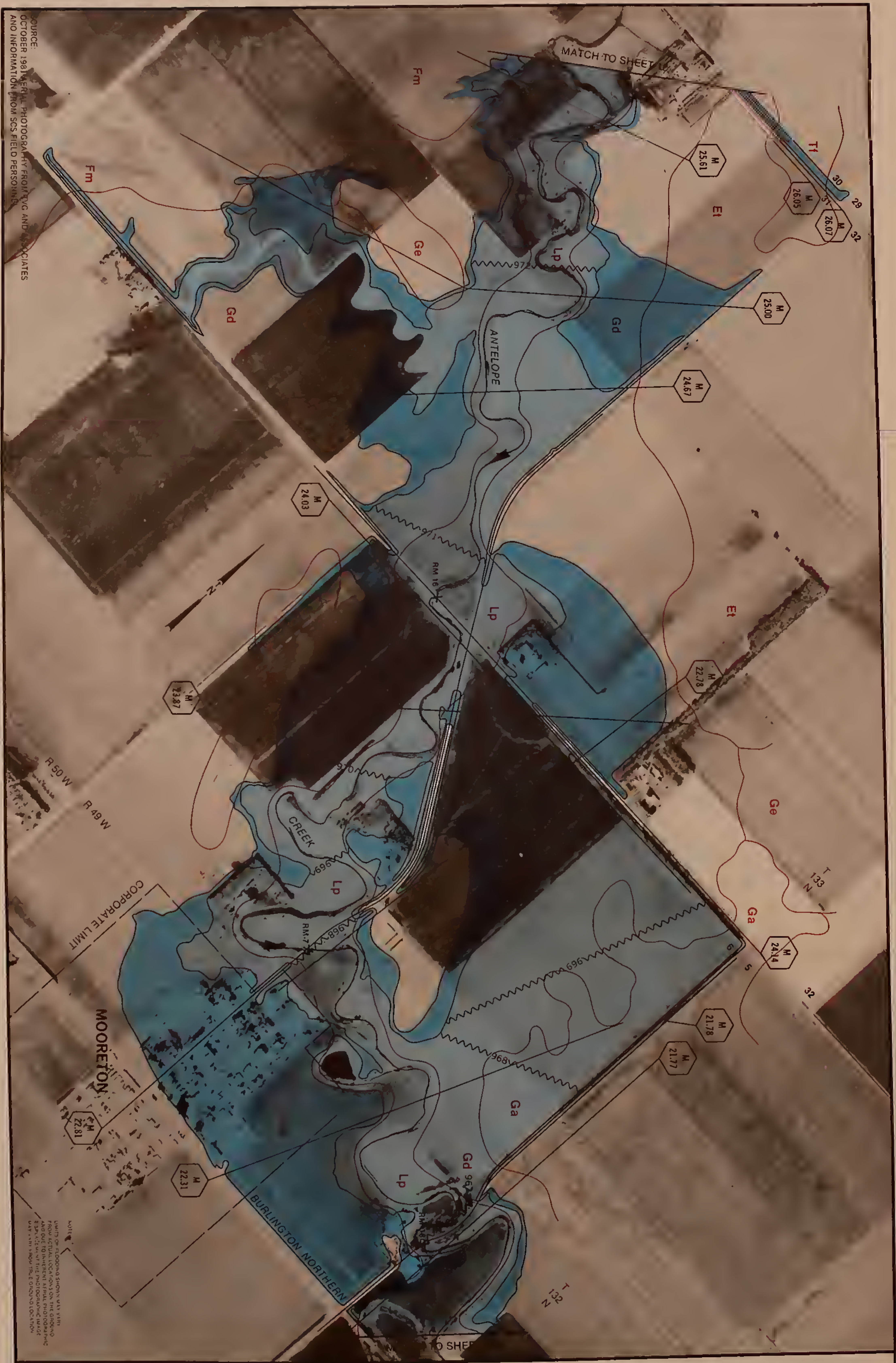
SHEET 10 OF 18

JUNE 1984 4R-38528

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

ANTELOPE CREEK



LEGEND

	100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)	M 12.93	VALLEY SECTION	Ga	SOILS AREA & SYMBOLS
	500 YEAR FREQUENCY FLOOD	952	ESTIMATED 100-YEAR FLOOD ELEVATION	RM 15 X	REFERENCE MARK
	STREAM CHANNEL				

SCALE 0 — 800 — 1600 FEET; 0 — 200 — 400 METERS APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

ANTELOPE CREEK

SHEET 11 OF 18

JUNE 1984 4R-38528

LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 12.93 VALLEY SECTION

952 ESTIMATED 100-YEAR FLOOD ELEVATION

Lp SOILS AREA & SYMBOLS

RM 15 X REFERENCE MARK

SCALE 0 800 1600 FEET; 0 200 400 METERS; APPROXIMATE

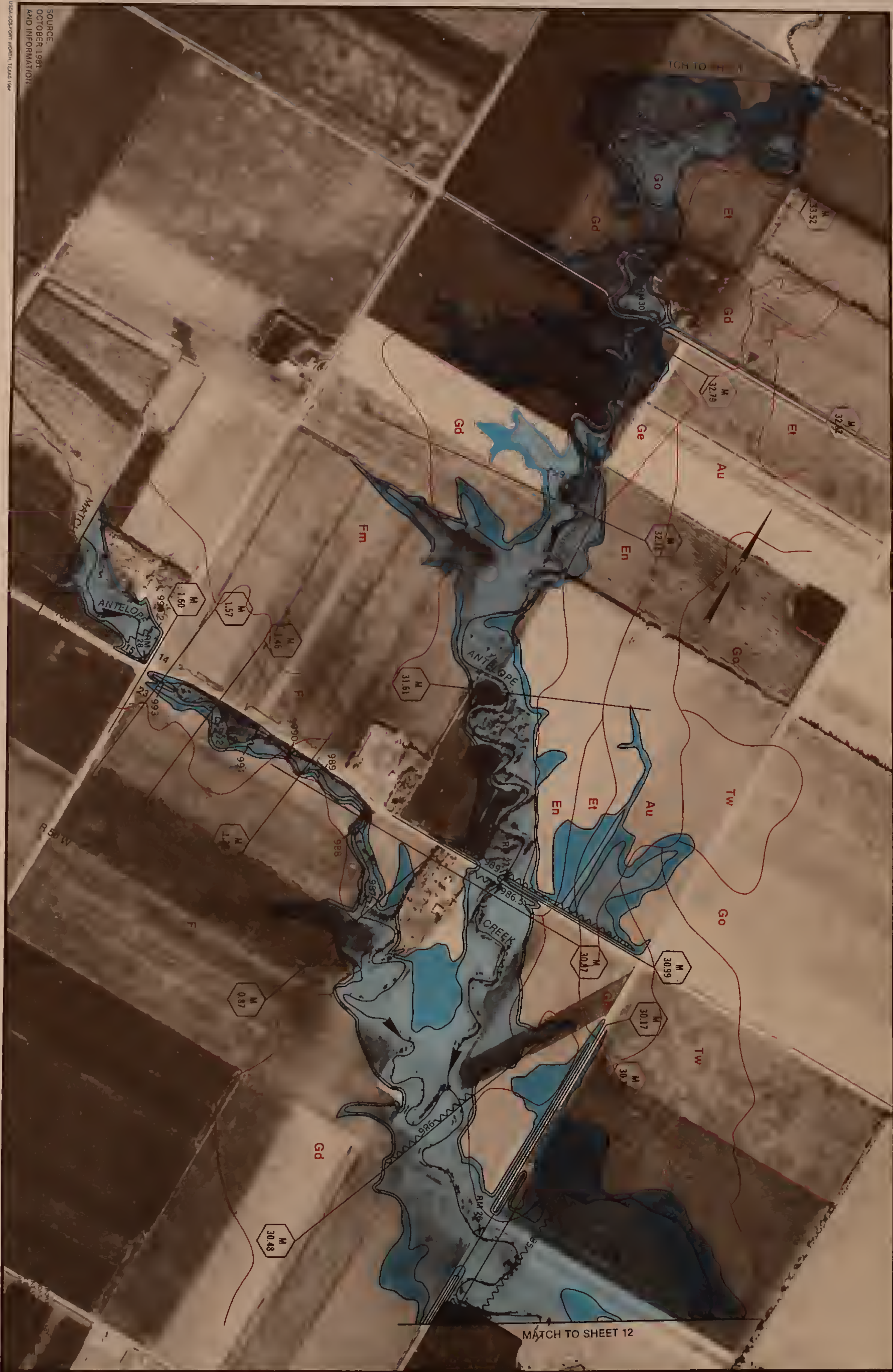
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

ANTELOPE CREEK

SHEET 12 OF 18

JUNE 1984 4R-38528



LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)	M 12.93 VALLEY SECTION
500 YEAR FREQUENCY FLOOD	952 ESTIMATED 100-YEAR FLOOD ELEVATION
STREAM CHANNEL	Fm SOILS AREA & SYMBOLS
	RM 15 X REFERENCE MARK

SCALE 0 800 1600 FEET
0 200 400 METERS
APPROXIMATE

SOURCE: OCTOBER 1981 AND INFORMATION

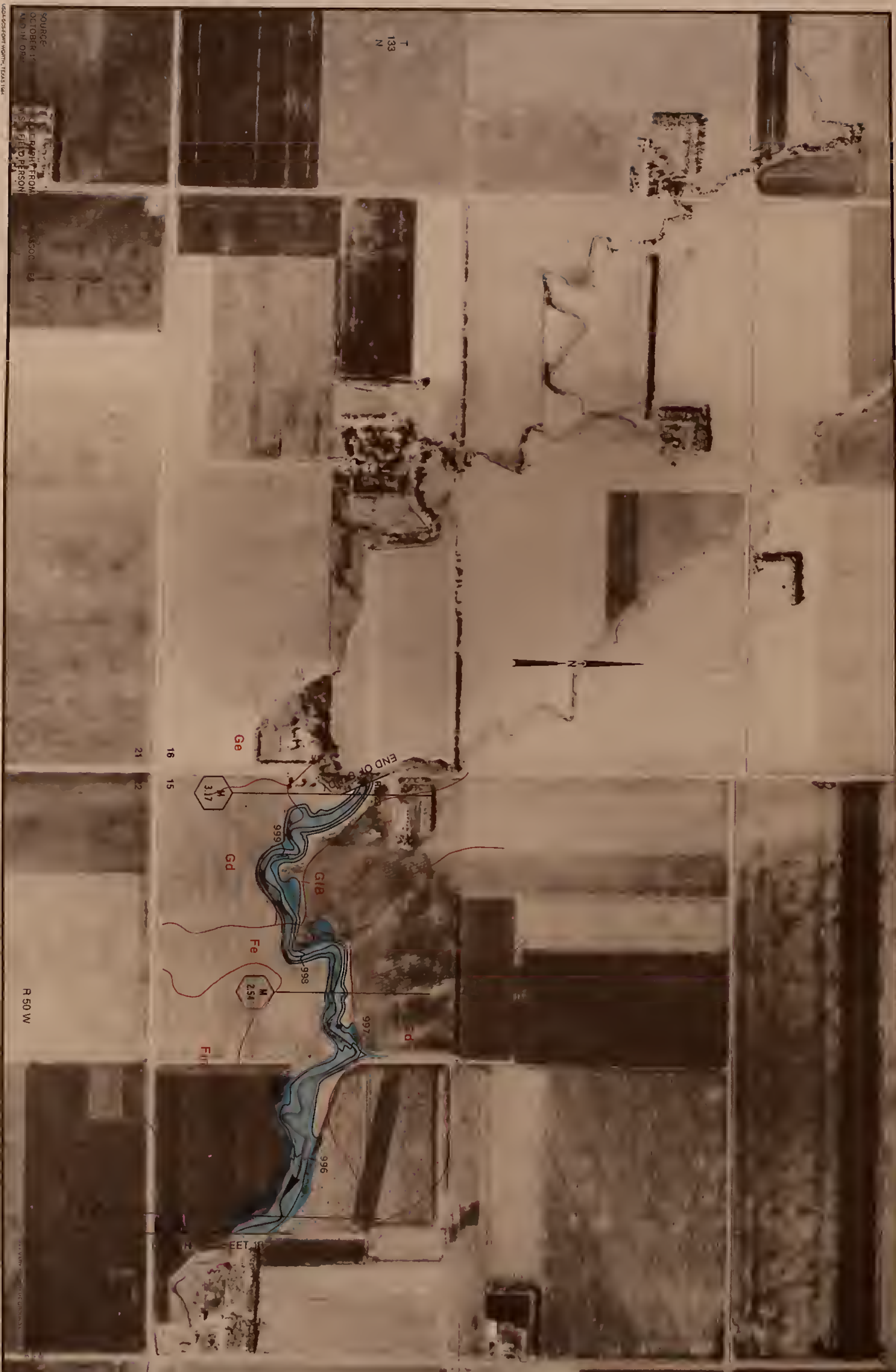
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

ANTELOPE CREEK AND TRIBUTARY

SHEET 13 OF 18

JUNE 1984 4R-38526



LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)	M 12.93 — VALLEY SECTION	GfB — SOILS AREA & SYMBOLS
500 YEAR FREQUENCY FLOOD	952 — ESTIMATED 100-YEAR FLOOD ELEVATION	RM 15 X — REFERENCE MARK
STREAM CHANNEL		

SCALE 0 — 800 — 1600 FEET; 0 — 200 — 400 METERS (APPROXIMATE)

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY

RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

ANTELOPE CREEK TRIBUTARY

SHEET 14 OF 18

JUNE 1984 4R-38528

LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 12.93 VALLEY SECTION

952 ESTIMATED 100-YEAR FLOOD ELEVATION

Ga SOILS AREA & SYMBOLS

RM 15 X REFERENCE MARK

SCALE 0 — 800 — 1600 FEET; 0 — 200 — 400 METERS (APPROXIMATE)

SHEET 15 OF 18

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

ANTELOPE CREEK

JUNE 1984 4R-38526

LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)	
500 YEAR FREQUENCY FLOOD	
STREAM CHANNEL	
M 12.93	VALLEY SECTION
952	ESTIMATED 100-YEAR FLOOD ELEVATION
Gu	SOILS AREA & SYMBOLS
RM 15 X	REFERENCE MARK

SCALE 0 — 800 — 1600 FEET
0 — 200 — 400 METERS
APPROXIMATE

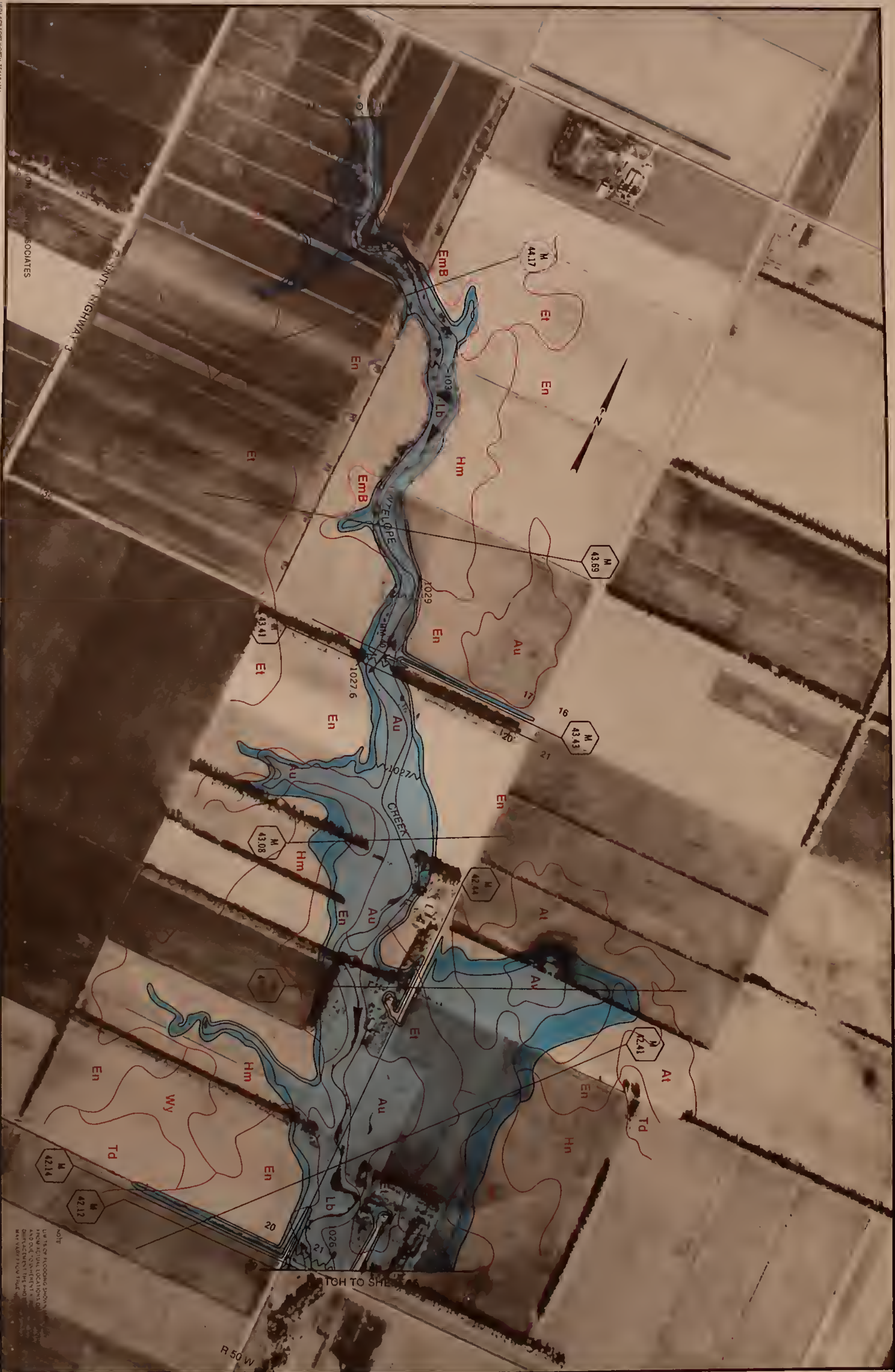
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

ANTELOPE CREEK

SHEET 16 OF 18

JUNE 1984 4R-38528



LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 12.93 VALLEY SECTION

952 ESTIMATED 100-YEAR FLOOD ELEVATION

Au SOILS AREA & SYMBOLS

RM 15 X REFERENCE MARK

SCALE 0 800 1600 FEET

0 200 400 METERS

APPROXIMATE

SHEET 17 OF 18

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

ANTELOPE CREEK

JUNE 1984 4R-38528

SOURCE:
OCTOBER 1981 AERIAL PHOTOGRAPHY FROM TVG AND ASSOCIATES
AND INFORMATION FROM SCS FIELD PERSONNEL

USDA-SCS-FORT WORTH, TEXAS 1984

LEGEND

- 100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)
- 500 YEAR FREQUENCY FLOOD
- STREAM CHANNEL
- M 12.93 — VALLEY SECTION
- 952 — ESTIMATED 100-YEAR FLOOD ELEVATION
- GfB — SOILS AREA & SYMBOLS
- RM 15 X — REFERENCE MARK

SCALE 0 — 800 — 1600 FEET
0 — 200 — 400 METERS
APPROXIMATE

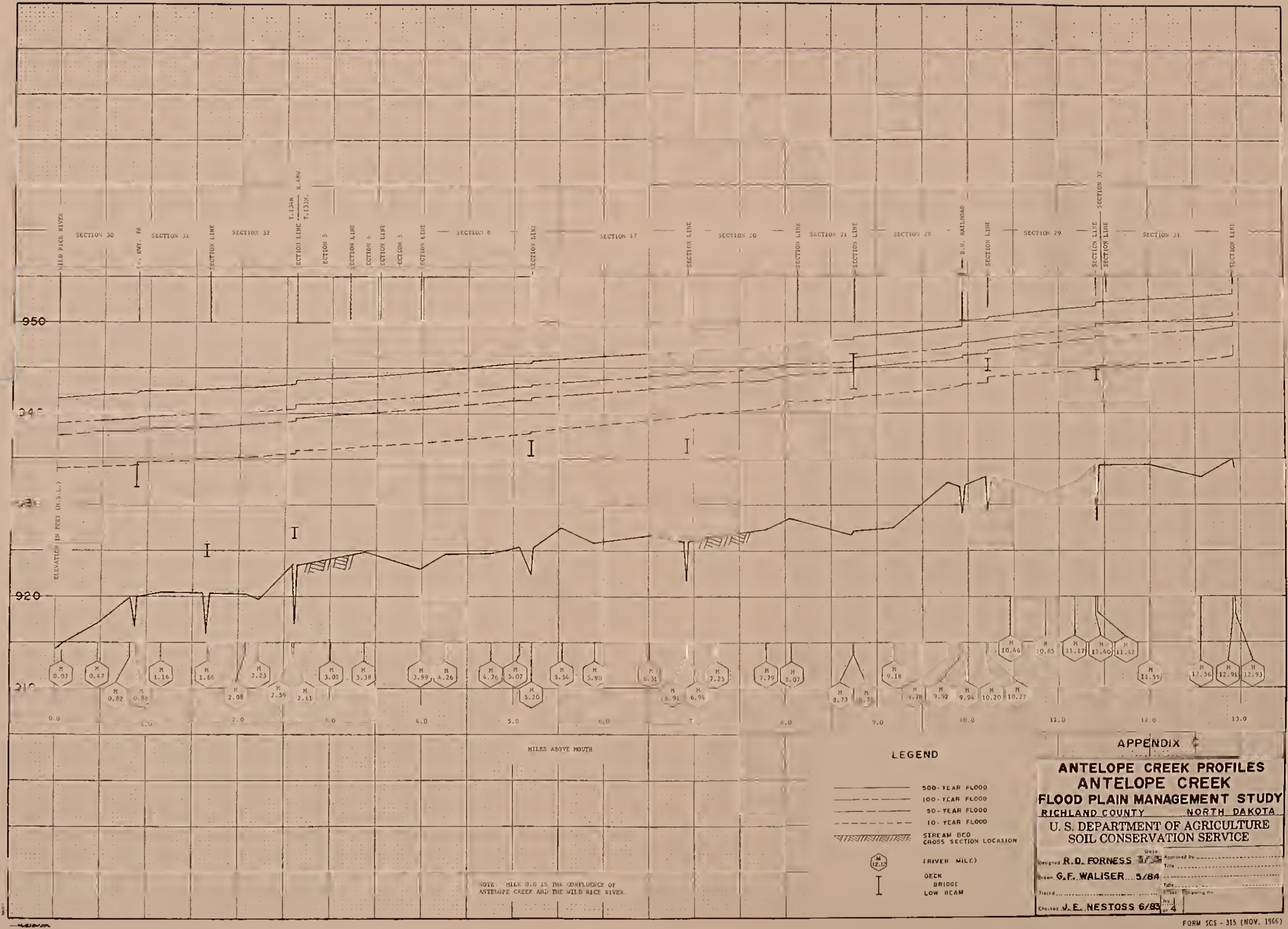
SHEET 18 OF 18

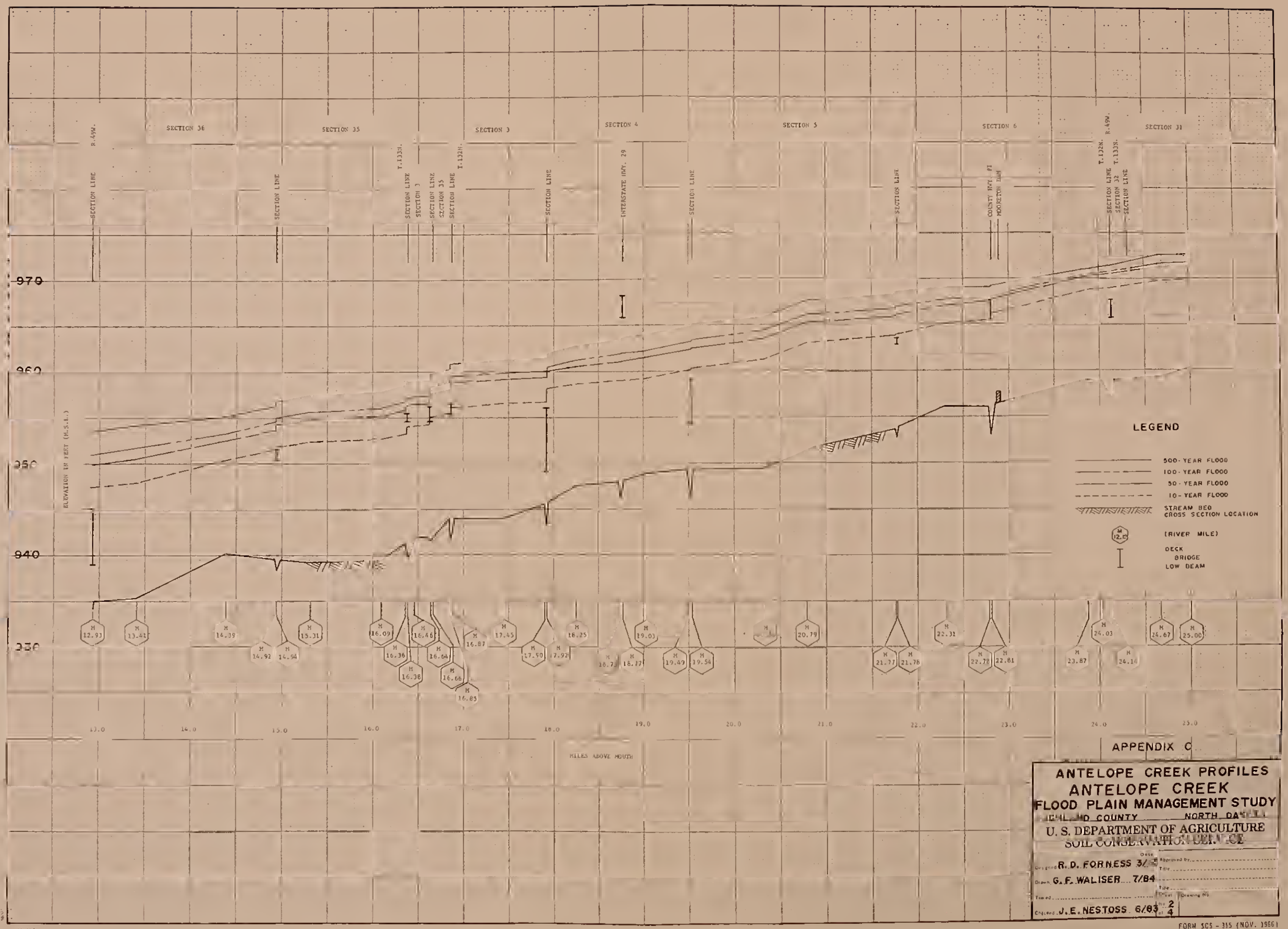
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY, NORTH DAKOTA

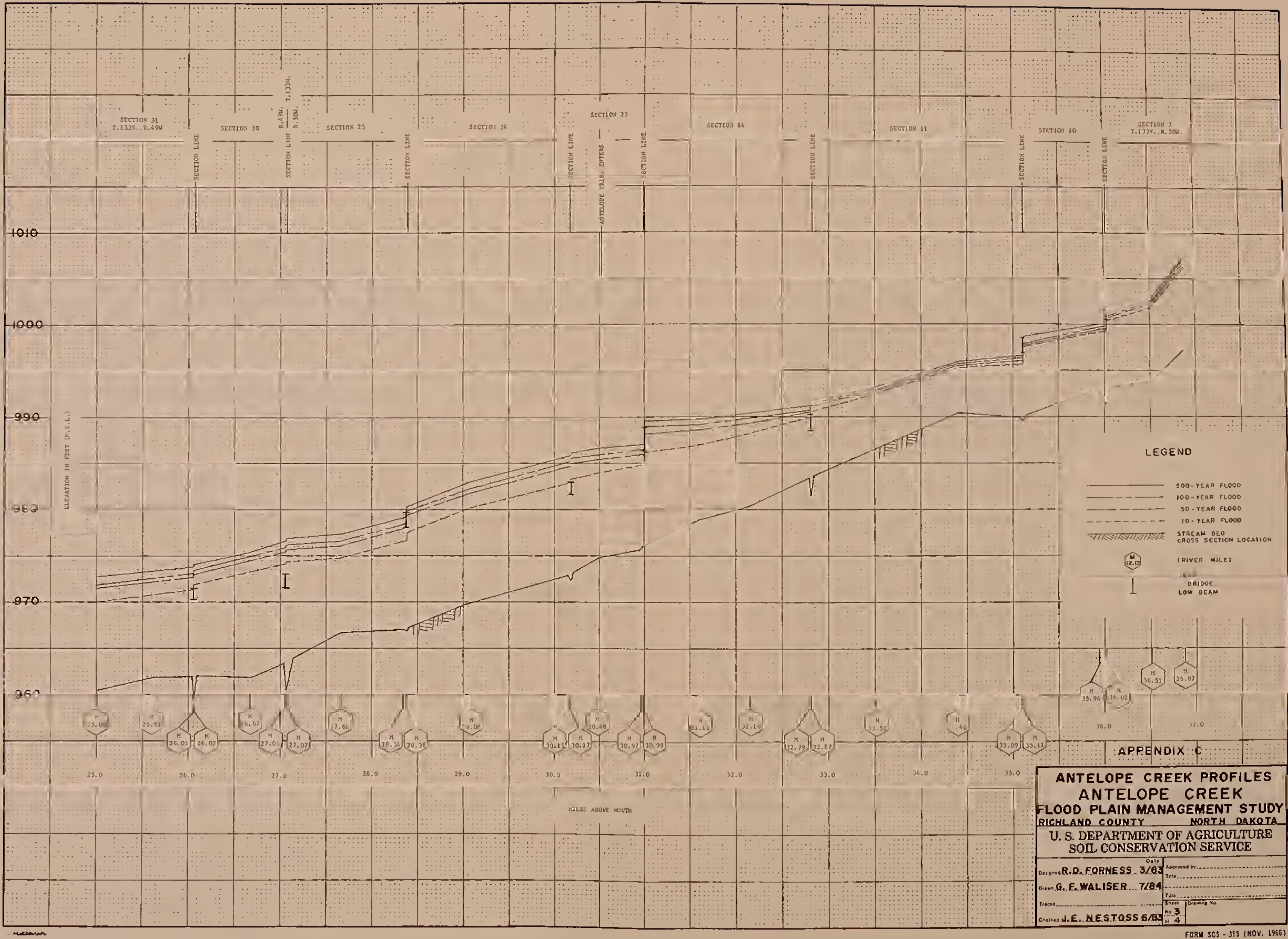
FLOOD HAZARD AREA

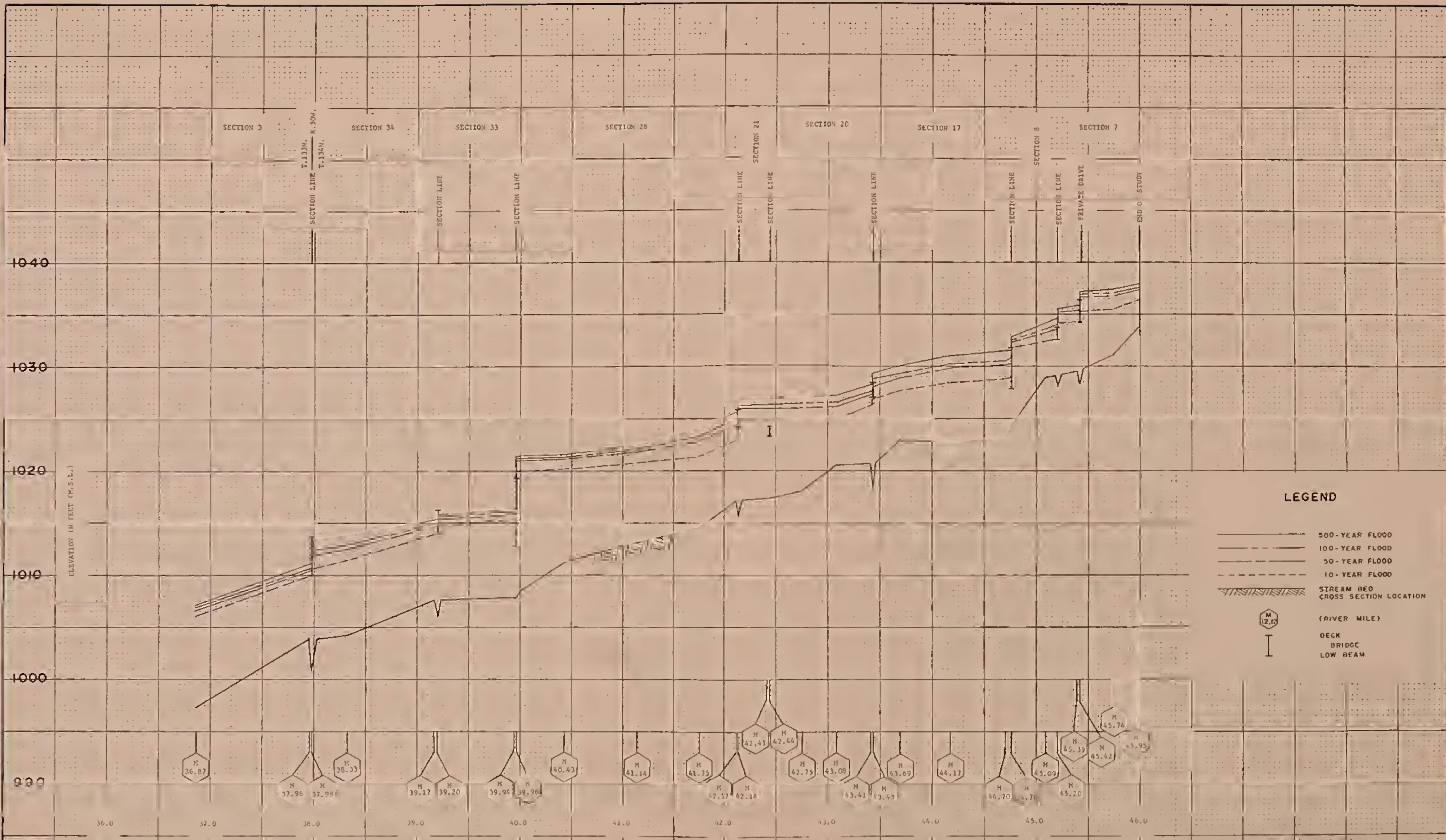
ANTELOPE CREEK

JUNE 1984 4R-38528


WILD RICE RIVER
SECTION 30
U.S. HWY. 81
SECTION 31
SECTION LINE
SECTION 32
T.134N
SECTION LINE
R.48W.
T.133N.
SECTION 5
SECTION LINE
SECTION 6
SECTION LINE
SECTION 5
SECTION LINE
SECTION 8
SECTION LINE
SECTION 17
SECTION LINE
SECTION 20
SECTION LINE
SECTION 21
SECTION LINE
SECTION 28
B.N. RAILROAD
SECTION LINE
SECTION 29
SECTION LINE
SECTION 32
SECTION LINE
SECTION 31
SECTION LINE
950
920
ELEVATION IN FEET (M.S.L.)
0.07
0.47
0.82
0.86
1.16
1.66
2.08
2.23
2.59
2.61
3.02
3.38
3.99
4.26
4.76
5.07
5.20
5.54
5.90
6.51
6.91
6.94
7.25
7.79
8.07
8.73
8.75
9.18
9.78
9.92
9.94
10.20
10.22
10.46
10.85
11.17
11.40
11.42
11.59
12.36
12.91
12.93
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
MILES ABOVE MOUTH
NOTE: MILE 0.0 IS THE CONFLUENCE OF ANTELOPE CREEK AND THE WILD RICE RIVER.
LEGEND
500-YEAR FLOOD
100-YEAR FLOOD
50-YEAR FLOOD
10-YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
(RIVER MILE)
DECK
BRIDGE
LOW BEAM
APPENDIX
ANTELOPE CREEK PROFILES
ANTELOPE CREEK
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY
NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed R.D. FORNESS
Drawn G.F. WALISER 5/84
Checked J.E. NESTOSS 6/83
Approved by
FORM SCS - 315 (NOV. 1966)


SECTION 36
SECTION 35
SECTION 3
SECTION 4
SECTION 5
SECTION 6
SECTION 31
R.49W.
T.133N.
T.132N.
SECTION LINE
SECTION 3
SECTION 35
INTERSTATE HWY. 29
COUNTY HWY. #1
MOORETON DAM
SECTION 32
970
960
950
940
930
ELEVATION IN FEET (M.S.L.)
LEGEND
500-YEAR FLOOD
100-YEAR FLOOD
50-YEAR FLOOD
10-YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
(RIVER MILE)
DECK
BRIDGE
LOW BEAM
12.93
13.41
14.39
14.92
14.94
15.31
16.09
16.36
16.38
16.46
16.64
16.66
16.85
16.87
17.45
17.50
17.92
18.25
19.03
19.49
19.54
20.79
21.77
21.78
22.31
22.78
22.81
23.87
24.03
24.14
24.67
25.00
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
MILES ABOVE MOUTH
APPENDIX C
ANTELOPE CREEK PROFILES
ANTELOPE CREEK
FLOOD PLAIN MANAGEMENT STUDY
U. S. DEPARTMENT OF AGRICULTURE
R. D. FORNESS
G. F. WALISER 7/84
J. E. NESTOSS 6/83
FORM SCS - 315 (NOV. 1966)


SECTION 31 T.133N., R.49W
SECTION 30
R.49W. R.50W. T.133N.
SECTION 25
SECTION 24
SECTION 23
SECTION 14
SECTION 11
SECTION 10
SECTION 3 T.133N., R.50W.
SECTION LINE
ANTELOPE TRIB. ENTERS
ELEVATION IN FEET (M.S.L.)
1010
1000
990
980
970
960
LEGEND
500-YEAR FLOOD
100-YEAR FLOOD
50-YEAR FLOOD
10-YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
(RIVER MILE)
BRIDGE
LOW BEAM
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
MILES ABOVE MOUTH
APPENDIX C
ANTELOPE CREEK PROFILES
ANTELOPE CREEK
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Date
Designed R.D. FORNESS 3/83
Drawn G. F. WALISER 7/84
Traced
Checked J.E. NESTOSS 6/83
Approved by
Title
Title
Sheet No. 3 of 4
Drawing No.
FORM SCS - 315 (NOV. 1966)



APPENDIX C

ANTELOPE CREEK PROFILES
ANTELOPE CREEK
FLOOD PLAIN MANAGEMENT STUDY

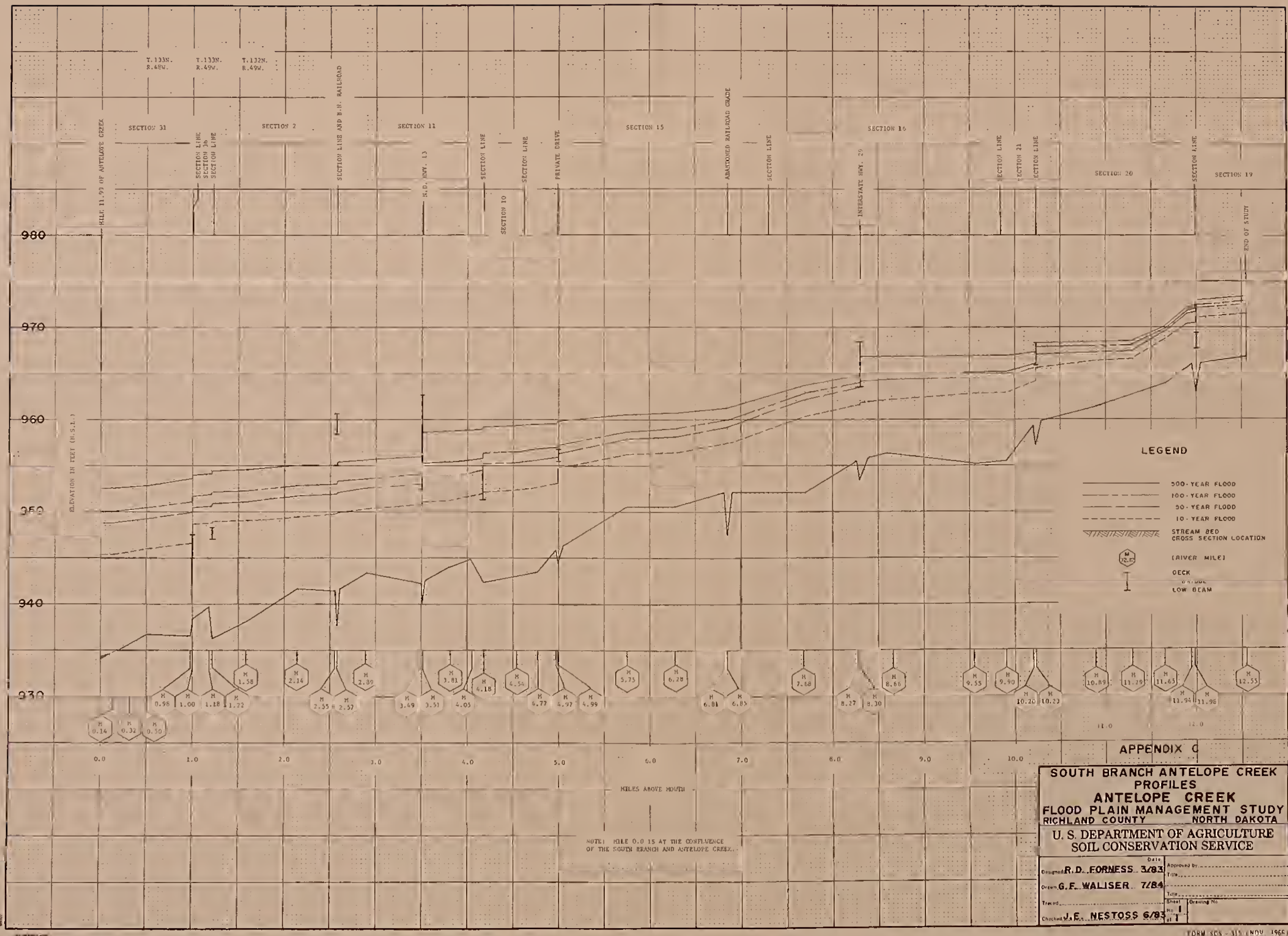
RICHLAND COUNTY — NORTH DAKOTA

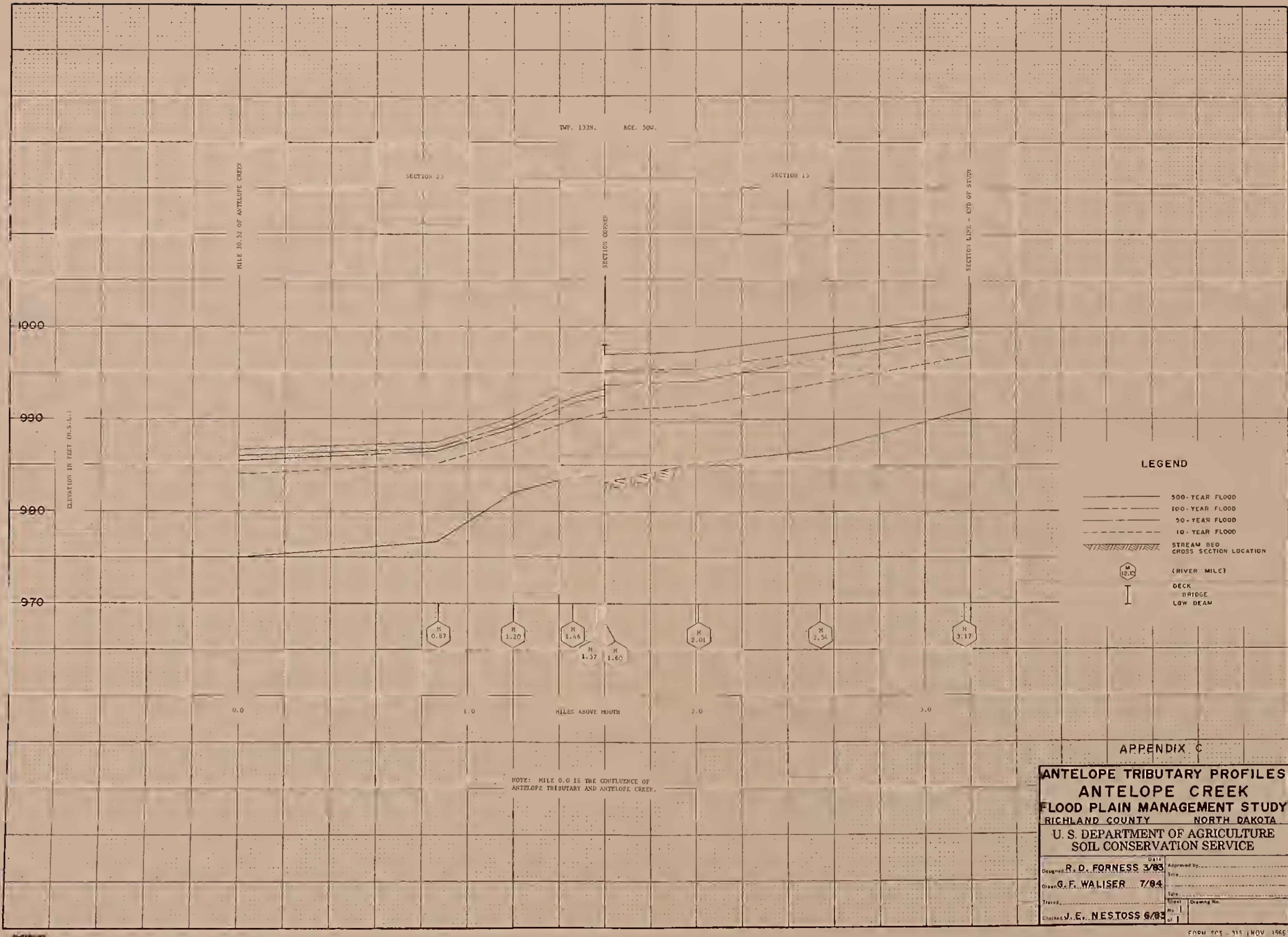
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed R. D. FORNESS 3/83
Drawn G. F. WALISER 7/83
Traced
Checked J. E. NESTOSS 6/83

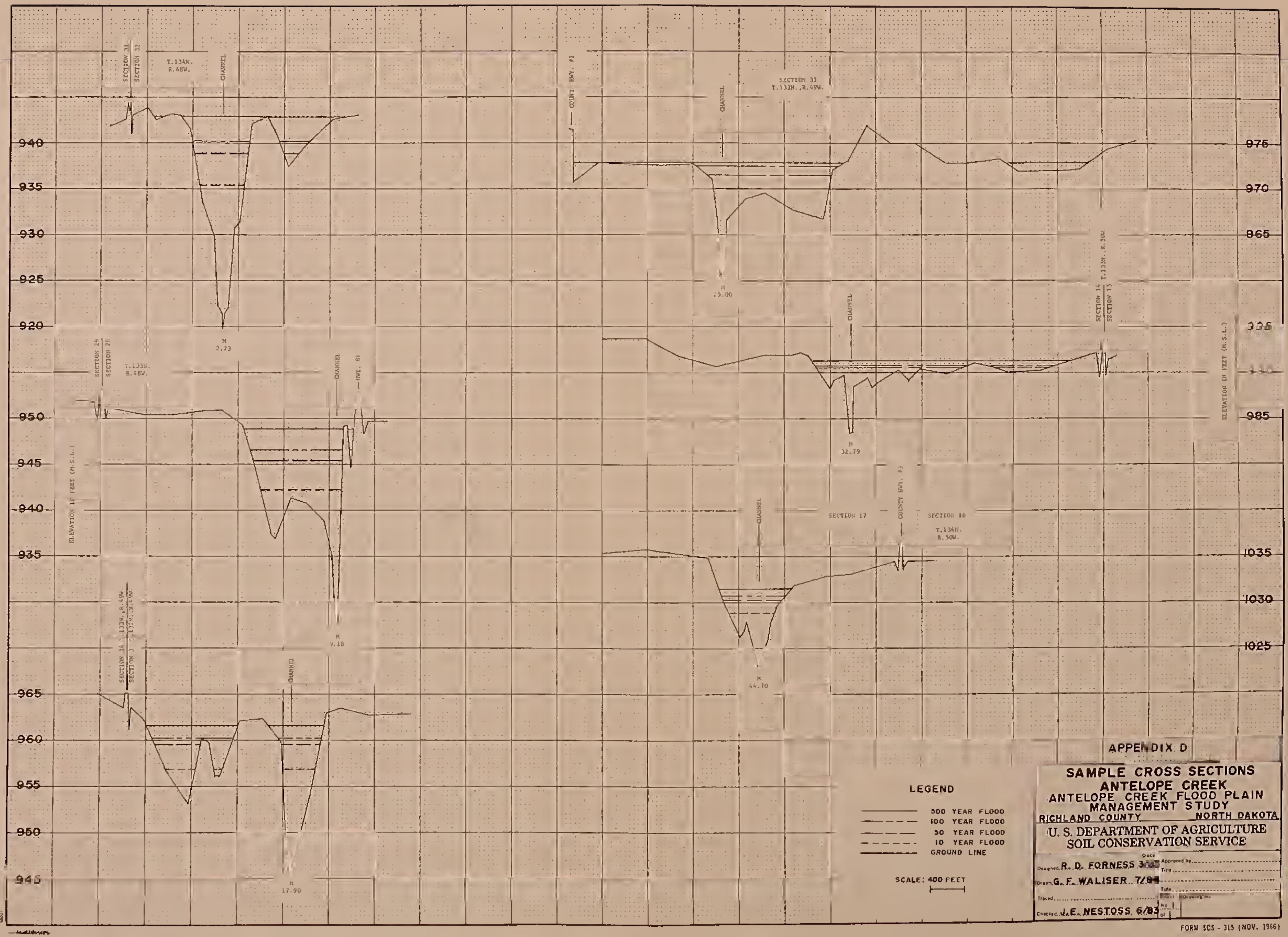
Sheet 4 of 4

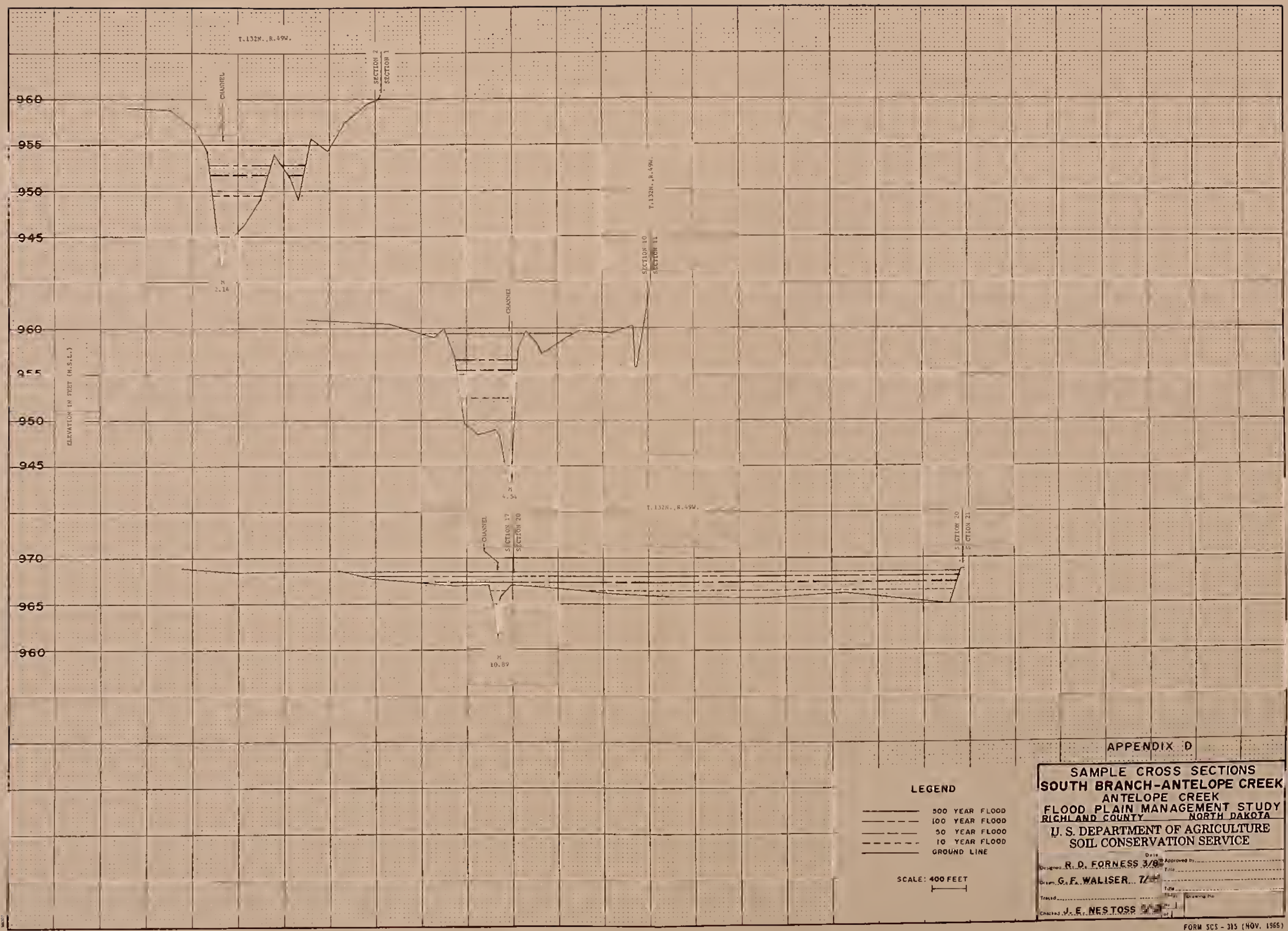
FORM SCS-315 (NOV. 1966)


T.133N. R.48W.
T.133N. R.49W.
T.132N. R.49W.
SECTION 31
SECTION 2
SECTION 11
SECTION 15
SECTION 16
SECTION 20
SECTION 19
MILE 11.93 OF ANTELOPE CREEK
SECTION LINE SECTION 36 SECTION LINE
SECTION LINE AND B.N. RAILROAD
N.D. HWY. 13
SECTION LINE
SECTION 10
SECTION LINE
PRIVATE DRIVE
ABANDONED RAILROAD GRADE
SECTION LINE
INTERSTATE HWY. 29
SECTION LINE
SECTION 21
SECTION LINE
SECTION LINE
END OF STUDY
ELEVATION IN FEET (M.S.L.)
980
970
960
950
940
930
LEGEND
500-YEAR FLOOD
100-YEAR FLOOD
50-YEAR FLOOD
10-YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
(RIVER MILE)
DECK
BRIDGE
LOW BEAM
0.14
0.32
0.50
0.98
1.00
1.18
1.38
1.72
2.14
2.55
2.57
2.89
3.49
3.51
3.81
4.05
4.18
4.54
4.77
4.97
4.99
5.75
6.28
6.81
6.85
7.68
8.27
8.30
8.66
9.55
9.90
10.20
10.23
10.89
11.29
11.63
11.94
11.98
12.53
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
MILES ABOVE MOUTH
NOTE: MILE 0.0 IS AT THE CONFLUENCE OF THE SOUTH BRANCH AND ANTELOPE CREEK.
APPENDIX C
SOUTH BRANCH ANTELOPE CREEK
PROFILES
ANTELOPE CREEK
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Date
Designed R.D. FORNESS 3/83
Drawn G.F. WALISER 7/84
Traced
Checked J.E. NESTOSS 6/83
Approved by
Title
Sheet No. 1 of 1
Drawing No.
FORM SCS-315 (NOV. 1966)



TWP. 133N. RGE. 50W.
SECTION 23
SECTION 13
MILE 30.52 OF ANTELOPE CREEK
SECTION CORNER
SECTION LINE - END OF STUDY
1000
990
980
970
ELEVATION IN FEET (M.S.L.)
LEGEND
500-YEAR FLOOD
100-YEAR FLOOD
50-YEAR FLOOD
10-YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
(RIVER MILE)
DECK
BRIDGE
LOW BEAM
M 0.87
M 1.20
M 1.46
M 1.57
M 1.60
M 2.01
M 2.54
M 3.17
0.0
1.0
MILES ABOVE MOUTH
2.0
3.0
NOTE: MILE 0.0 IS THE CONFLUENCE OF ANTELOPE TRIBUTARY AND ANTELOPE CREEK.
APPENDIX C
ANTELOPE TRIBUTARY PROFILES
ANTELOPE CREEK
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed R. D. FORNESS 3/83
Drawn G. F. WALISER 7/84
Traced
Checked J. E. NESTOSS 6/83
Approved by
Title
Title
Sheet
Drawing No.
No. 1
of 1
FORM SCS - 315 (NOV. 1966)


SECTION 31
SECTION 32
T.134N.
R.48W.
CHANNEL
M
2.23
COUNTY HWY. 81
CHANNEL
SECTION 31
T.133N. R.49W.
M
25.00
SECTION 29
SECTION 28
T.133N.
R.48W.
CHANNEL
HWY. 81
M
9.18
CHANNEL
SECTION 14
SECTION 15
T.133N. R.50W.
M
32.79
SECTION 34 T.133N. R.49W.
SECTION 3 T.132N. R.49W.
CHANNEL
M
17.90
CHANNEL
SECTION 17
COUNTY HWY. 83
SECTION 18
T.134N.
R.50W.
M
44.70
ELEVATION IN FEET (M.S.L.)
940
935
930
925
920
950
945
940
935
965
960
955
950
945
975
970
965
935
930
985
1035
1030
1025
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
GROUND LINE
SCALE: 400 FEET
APPENDIX D
SAMPLE CROSS SECTIONS
ANTELOPE CREEK
ANTELOPE CREEK FLOOD PLAIN
MANAGEMENT STUDY
RICHLAND COUNTY
NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed R. D. FORNESS
Drawn G. F. WALISER 7/83
Checked J. E. NESTOSS 6/83
FORM SCS - 315 (NOV. 1966)


T.132N., R.49W.
SECTION 2
SECTION 1
CHANNEL
960
955
950
945
M
3.14
T.132N., R.49W.
SECTION 10
SECTION 11
CHANNEL
960
955
950
945
ELEVATION IN FEET (M.S.L.)
M
4.54
T.132N., R.49W.
CHANNEL
SECTION 17
SECTION 20
SECTION 20
SECTION 21
970
965
960
M
10.89
APPENDIX D
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
GROUND LINE
SCALE: 400 FEET
SAMPLE CROSS SECTIONS
SOUTH BRANCH-ANTELOPE CREEK
ANTELOPE CREEK
FLOOD PLAIN MANAGEMENT STUDY
RICHLAND COUNTY
NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed R. D. FORNESS
Drawn G. F. WALISER
Traced
Checked J. E. NESTOSS
Approved by
Title
Drawing No.
FORM SCS - 315 (NOV. 1966)

DISCHARGE-FREQUENCY DATA

ANTELOPE CREEK

RICHLAND COUNTY

APPENDIX E

ANTELOPE CREEK					
BETWEEN RIVER MILES	DRAINAGE AREA (SQUARE MILES)	500-YEAR FREQ. FLOOD Q (CFS)	100-YEAR FREQ. FLOOD Q (CFS)	50-YEAR FREQ. FLOOD Q (CFS)	10-YEAR FREQ. FLOOD Q (CFS)
0.00					
	339	11,500	8,000	6,400	3,100
0.88					
	298	10,400	7,300	5,800	2,850
8.73					
	290	10,000	7,200	5,600	2,750
11.99					
	178	7,000	4,900	3,900	1,900
24.67					
	120	4,235*	3,125*	2,575*	1,430
30.48					
	76	1,950*	1,550*	1,390*	1,000
42.41					
	29	1,780	1,240	980	480
46.00					

* Discharges reduced due to breakout at river mile 40.

SOUTH BRANCH					
BETWEEN RIVER MILES	DRAINAGE AREA (SQUARE MILES)	500-YEAR FREQ. FLOOD Q (CFS)	100-YEAR FREQ. FLOOD Q (CFS)	50-YEAR FREQ. FLOOD Q (CFS)	10-YEAR FREQ. FLOOD Q (CFS)
0.00					
	96	4,400	3,100	2,450	1,200
6.28					
	55	2,900	2,000	1,600	780
12.55					

ANTELOPE TRIBUTARY					
0.00					
	37	2,100	1,480	1,180	580
3.19					

WATER SURFACE ELEVATION - FREQUENCY DATA

ANTELOPE CREEK

RICHLAND COUNTY

APPENDIX F

ANTELOPE CREEK EXISTING CONDITION

RIVER MILE 1/	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
0.07	941.7	938.9	937.6	933.9
0.47	942.0	939.2	937.9	934.1
0.82	942.2	939.4	938.0	934.2
0.88	942.4	939.6	938.2	934.6
1.16	942.5	939.7	938.3	934.7
1.66	942.7	939.9	938.5	934.9
2.08	942.9	940.2	938.8	935.2
2.23	942.9	940.2	938.8	935.3
2.59	943.2	940.5	939.2	935.6
2.61	943.7	941.0	939.5	935.9
3.01	943.9	941.2	939.8	936.1
3.38	944.1	941.5	940.1	936.4
3.99	944.6	941.9	940.5	936.8
4.26	944.9	942.2	940.8	937.1
4.76	945.4	942.7	941.3	937.5
5.07	945.7	943.0	941.6	937.8
5.20	945.9	943.2	941.8	938.1
5.54	946.1	943.5	942.1	938.4
5.90	946.3	943.7	942.3	938.7

1/ River mile 0.0 is at the confluence of the Wild Rice River

ANTELOPE CREEK EXISTING CONDITION

RIVER MILE 1/	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
6.51	946.6	944.1	942.7	939.3
6.91	946.7	944.2	942.9	939.6
6.94	947.0	944.4	943.1	939.7
7.25	947.1	944.6	943.3	940.1
7.79	947.3	944.8	943.5	940.5
8.07	947.8	945.4	944.2	941.3
8.73	948.1	945.7	944.5	941.6
8.75	948.5	946.2	945.0	941.8
9.18	948.8	946.6	945.4	942.2
9.78	949.3	947.2	945.9	942.8
9.92	949.5	947.4	946.1	943.1
9.94	950.2	947.8	946.4	943.2
10.20	950.3	947.9	946.6	943.3
10.22	950.6	948.2	947.0	944.0
10.46	950.8	948.4	947.2	944.1
10.85	951.3	948.8	947.6	944.4
11.17	951.6	949.1	947.9	944.6
11.40	951.8	949.4	948.2	944.9
11.42	952.2	949.8	948.5	945.1
11.99	952.6	950.1	948.8	945.4
12.56	952.9	950.4	949.1	945.8
12.91	953.1	950.7	949.5	946.3
12.93	953.6	951.2	949.9	947.5
13.41	954.2	951.8	950.6	948.0

ANTELOPE CREEK EXISTING CONDITION

RIVER MILE 1/	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
14.39	955.2	953.4	952.5	950.5
14.92	956.3	954.6	953.7	951.6
14.94	956.8	955.1	954.3	951.9
15.31	957.6	955.8	954.9	952.4
16.09	957.9	956.1	955.2	952.8
16.36	958.6	956.8	955.8	953.3
16.38	959.1	957.3	956.4	954.2
16.46	959.1	957.3	956.5	954.2
16.64	959.9	958.5	957.7	955.2
16.66	959.9	958.5	957.7	955.2
16.85	960.4	958.9	958.1	955.5
16.87	961.0	959.6	958.9	956.2
17.45	961.4	960.0	959.3	956.7
17.90	961.6	960.2	959.5	956.8
17.92	962.0	960.7	960.0	958.4
18.25	962.8	961.3	960.6	958.7
18.73	963.4	961.9	961.1	959.0
18.77	963.7	962.1	961.2	959.1
19.03	964.0	962.3	961.5	959.2
19.49	964.8	963.2	962.3	960.1
19.54	965.1	963.5	962.6	960.4
20.33	965.9	964.4	963.5	961.3
20.79	967.7	966.1	965.3	963.1

ANTELOPE CREEK EXISTING CONDITION

RIVER MILE 1/	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
21.77	968.4	966.8	965.9	963.8
21.78	968.7	967.0	966.1	963.9
22.31	969.1	967.8	967.1	965.2
22.78	969.2	968.0	967.5	965.5
22.81	969.3	968.1	967.8	966.2
23.87	971.2	970.6	970.3	968.8
24.03	971.4	970.7	970.5	968.9
24.14	971.5	970.8	970.6	969.0
24.67	972.7	971.8	971.4	969.8
25.00	972.8	971.9	971.5	970.0
25.61	973.4	972.6	972.2	970.9
26.05	973.9	973.1	972.6	971.3
26.07	974.2	973.4	973.0	971.9
26.67	975.4	974.9	974.5	973.3
27.05	976.6	975.9	975.4	974.1
27.07	976.9	976.2	975.7	974.4
27.66	977.4	976.6	976.1	974.8
28.34	979.2	978.4	978.0	976.6
28.38	980.3	979.8	979.4	977.6
29.08	983.0	982.3	981.8	980.2
30.15	985.8	985.2	984.7	982.9
30.17	986.2	985.6	985.0	983.3
30.48	986.7	986.0	985.5	984.0
30.97	987.1	986.5	986.0	984.9

ANTELOPE CREEK EXISTING CONDITION

RIVER MILE 1/	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
30.99	989.6	989.0	988.2	986.2
31.61	989.8	989.2	988.6	987.0
32.16	990.4	989.8	989.3	988.2
32.79	991.2	990.7	990.5	990.0
32.82	991.7	991.4	991.3	990.6
33.52	993.3	993.0	992.9	992.7
34.40	996.0	995.8	995.7	995.6
35.09	996.7	996.5	996.2	995.9
35.11	998.7	998.0	997.8	997.7
35.94	1000.1	999.7	999.5	999.4
36.02	1001.1	1000.9	1000.8	1000.5
36.51	1002.9	1002.5	1002.3	1001.8
36.87	1007.3	1006.8	1006.5	1006.1
37.96	1011.1	1010.7	1010.5	1009.9
37.98	1013.5	1012.4	1012.0	1010.7
38.33	1013.8	1012.9	1012.5	1011.5
39.17	1015.5	1015.0	1014.7	1014.1
39.20	1015.9	1015.5	1015.3	1014.9
39.94	1016.5	1016.1	1016.0	1015.4
39.96	1021.4	1021.2	1021.1	1020.0
40.43	1021.5	1021.3	1021.2	1020.2
41.14	1022.5	1022.1	1021.9	1020.8
41.75	1024.1	1023.3	1022.9	1021.4
42.12	1025.5	1024.6	1024.0	1022.6

ANTELOPE CREEK EXISTING CONDITION

RIVER MILE 1/	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
42.14	1026.8	1026.3	1025.9	1024.9
42.41	1026.9	1026.3	1025.9	1024.9
42.44	1027.0	1026.4	1026.0	1024.9
42.75	1027.1	1026.5	1026.1	1024.9
43.08	1027.3	1026.6	1026.2	1025.0
43.41	1028.3	1027.6	1027.3	1026.3
43.43	1029.4	1028.8	1028.1	1026.9
43.69	1030.1	1029.4	1028.9	1027.7
44.17	1031.1	1030.3	1029.8	1028.5
44.70	1031.5	1030.7	1030.2	1028.8
44.76	1032.9	1032.6	1032.4	1031.9
45.09	1034.3	1033.7	1033.4	1032.5
45.20	1035.7	1035.3	1035.1	1034.3
45.39	1035.9	1035.4	1035.2	1034.3
45.42	1037.3	1037.0	1036.8	1035.4
45.74	1037.5	1037.2	1036.9	1035.6
45.98	1038.0	1037.6	1037.4	1036.5

WATER SURFACE ELEVATION - FREQUENCY DATA

SOUTH BRANCH - ANTELOPE CREEK

RICHLAND COUNTY

APPENDIX F

SOUTH BRANCH - ANTELOPE CREEK EXISTING CONDITION

RIVER MILE 1/	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
0.14	952.6	950.1	948.8	945.4
0.50	952.8	950.4	949.2	946.0
0.98	953.6	951.1	949.9	946.6
1.00	954.0	951.7	950.5	948.7
1.18	954.1	951.8	950.6	948.8
1.22	954.5	952.1	950.9	948.9
1.58	954.6	952.3	951.1	949.0
2.14	955.0	952.8	951.7	949.5
2.55	955.1	953.0	951.9	949.8
2.57	955.5	953.3	952.1	949.9
2.89	955.7	953.6	952.6	950.4
3.49	956.1	954.1	953.0	950.9
3.51	958.7	955.4	953.9	951.1
3.81	958.8	955.5	954.0	951.3
4.05	958.9	955.7	954.3	951.8
4.18	959.3	956.4	955.3	952.2
4.54	959.4	956.6	955.4	952.4
4.77	959.6	956.9	955.7	952.7
4.97	959.7	957.1	956.0	953.1

1/ River mile 0.0 is as R.M. 11.99 of the Antelope Creek

SOUTH BRANCH - ANTELOPE CREEK EXISTING CONDITION

RIVER MILE 1/	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
4.99	959.9	957.3	956.4	954.8
5.75	960.7	958.8	958.0	956.3
6.28	960.8	959.1	958.2	956.5
6.81	961.3	960.0	959.3	957.6
6.85	961.3	960.0	959.3	957.6
7.68	964.0	963.0	962.2	960.5
8.27	964.9	964.0	963.5	961.7
8.30	967.0	965.0	964.2	961.9
8.66	967.0	965.1	964.4	962.2
9.55	967.0	965.3	964.6	962.9
9.90	967.1	965.3	964.6	963.0
10.20	967.4	966.1	965.6	964.1
10.23	968.4	967.9	967.1	965.5
10.89	968.5	968.0	967.3	966.4
11.29	968.6	968.1	967.5	966.6
11.65	970.2	969.9	969.7	968.8
11.94	972.3	971.7	971.6	970.4
11.98	973.0	972.4	972.2	971.1
12.55	973.4	972.9	972.5	971.5

WATER SURFACE ELEVATION - FREQUENCY DATA

ANTELOPE CREEK TRIBUTARY

RICHLAND COUNTY

APPENDIX F

ANTELOPE CREEK TRIBUTARY EXISTING CONDITION

RIVER MILE 1/	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
0.87	987.5	986.9	986.5	985.1
1.20	990.2	989.4	988.9	987.5
1.46	993.2	992.3	991.6	989.8
1.57	994.0	993.0	992.3	990.5
1.60	997 0	995.2	993.7	990.8
2.01	997.3	995.5	994.1	991.5
2.54	999.0	997.4	996.4	994.0
3.17	1001.3	999.9	998.9	996.7

1/ River mile 0.0 is at R.M. 30.52 of the Antelope Creek

APPENDIX G

INVESTIGATION & ANALYSES

Surveys

A bench mark circuit was established throughout the study area using existing U.S.G.S. Coast and Geodetic Bench Marks. Elevation reference marks are scattered throughout the study area. These reference marks can be used to determine flood elevations as indicated in this flood hazard analyses. Detailed locations, descriptions and elevations can be obtained from Appendix J. Third order levels were used as the base of accuracy in field surveys.

A total of 174 channel and flood plain cross sections, covering a channel mile distance of 61.74 miles, were analyzed.

The geometry of all bridges and culverts were measured and used in computing the water surface profiles.

All cross sections are located on the photomaps (Appendix B, Sheets 1 to 18).

Photogrammetry

High and low level aerial photography flights were flown in October 1981. The low level aerial photography was used for digitizing the cross sections and securing other topographic features. The high level photography was used for compilation of the final photo maps. Digitized cross sections were used to compute water surface profiles for 10-, 50-, 100- and 500-year floods. The 100-year and 500-year curvilinear flood boundaries were stereo plotted using elevations computed from water surface profiles.

Hydrology and Hydraulics

Peak discharges for the 10-, 50-, 100-, and 500-year frequencies were determined by procedures contained in Soil Conservation Service National Engineering Handbook, Section 4, Hydrology. Frequency curves were developed for gages on Antelope Creek near Dwight and the Rush River near Amenia using the procedures of Water Resources Council Bulletin 17. Frequency data for smaller watersheds was obtained from the Hydrology Manual for North Dakota. A logrithmic plot of discharge versus drainage area was used to estimate discharges throughout the watershed.

At approximately river mile 40, part of the flow for the 50-year through 500-year discharge overflows the watershed boundary. Part of this overflow returns to Antelope Creek in the vacinity of this spillover area. However, most of the overflow enters Richland County Legal Drain #72, a tributary of the Wild Rice River. To account for the overflow, discharges at mile 40 were reduced by the following amounts:

10 yr	-	0 cfs
50 yr	-	650 cfs
100 yr	-	1050 cfs
500 yr	-	1750 cfs

Between river mile 30.5 and 40.4, discharges were reduced by the full amount shown above. Between river mile 24.7 and 30.5, the discharges were reduced by approximately one half the above amount. Downstream of river mile 24.7, no reduction in discharge was made because data for the gage on Antelope Creek near Dwight should reflect any past overflows above the gage. The revised discharges are shown in Appendix E.

A second overflow area occurs at approximately river mile 12 on the South Branch of Antelope Creek. Overflows are shallow, sheet flow and enter the main branch of Antelope Creek at approximately river mile 20. No attempt was made to delineate the area flooded by the overflows. Rates of discharge are

estimated to be insignificant and downstream discharges were not modified for the overflows.

The drainage area at the beginning of the study area is approximately 339 square miles and reduced to 29 square miles at the upper end.

Water surface elevations for the 10-, 50-, 100- and 500-year flood events were computed using the U.S. Soil Conservation Service WSP-2 computer program, which performs subcritical backwater computations by a modified step method. The program includes head loss computations at restrictive sections such as roadway bridge openings or culverts, using the U.S. Bureau of Public Roads Method.

Roughness coefficients (Manning's "n") used in the hydraulic computations were chosen using U.S. Soil Conservation Service guidelines. The channel value varied form 0.040 to 0.065 while the flood plain value ranged from 0.060 to 0.12. To determine the starting elevations at the mouth of Antelope Creek, (mile 0.00), water surface profiles were computed on the Wild Rice River, based on data from the Abercrombie Gage.

The hydraulic analyses for this study were based on unobstructed flow. The flow elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly and do not fail. The 100-year flood was computed to emphasize the effect of constrictions (bridge openings) on flooding and provide a basis for analyzing future improvements. Future projections indicate that expected encroachment will affect the flood stages a slight amount within the study area. The 100-year flood also serves as the base flood which HUD considers as a minimum for flood insurance requirements.

EXISTING BRIDGES AND CULVERTS

APPENDIX H

Bridges and culverts existing at the time of study and used to develop the water surface profile data contained in this document are shown pictorially on the following pages.

The pictures should be helpful in the future to visually check which bridging was in place at the time of study, which were restrictive or in need of replacement and which have been subsequently replaced thus affecting localized flood plains.

M 0.88 Sections 30 and 31, T. 134 N., R. 48 W.

M 1.66 Sections 31 and 32, T. 134 N., R. 48 W.

M 2.61 Sections $\frac{32,\ T.\ 134\ N.}{5,\ T.\ 133\ N.}$ R. 48 W.

M 5.20 Sections 5 and 8, T. 133 N., R. 48 W.

M 8.75 Sections 21 and 28, T. 133 N., R. 48 W.

M 10.22 Sections 28 and 29, T. 133 N., R. 48 W.

M 6.94 Sections 17 and 20, T. 133 N., R. 48 W.

M 9.94 B.N. Railroad Bridge at Dwight, ND

M 11.42 Sections 29 and 32, T. 133 N., R. 48 W.

M 12.93 Sections $\frac{\text{31, R. 58 W.}}{\text{35, R. 49 W.}}$ T. 133 N.

M 14.94 Sections 35 and 36, T. 133 N., R. 49 W.

M 16.38 East Bridge Sections $\frac{\text{3, T. 132 N.}}{\text{35, T. 133 N.}}$ R. 49 W.

M 16.87 West Bridge Sections $\frac{\text{3, T. 132 N.}}{\text{35, T. 133 N.}}$ R. 49 W.

M 16.64 Middle Bridge Sections $\frac{\text{3, T. 133 N.}}{\text{35, T. 133 N.}}$ R. 49 W.

M 18.77 Interstate Highway No. 29

M 17.92 Sections 3 and 4, T. 132 N., R. 49 W.

M 21.78 Sections 5 and 6, T. 132 N., R. 49 W.

M 19.54 Sections 4 and 5, T. 132 N., R. 49 W.

M 24.14 Sections $\frac{6,\ T.\ 132\ N.}{32,\ T.\ 133\ N.}$ R. 49 W.

M 22.81 County Highway North of Mooreton

M 26.07 Sections 30 and 31, T. 133 N. R. 49 W.

M 27.07 Sections $\frac{\text{25, R. 50 W.}}{\text{30, R. 49 W.}}$ T. 133 N.

M 28.38 Sections 24 and 25, T. 133 N., R. 50 W.

M 30.17 Sections 23 and 24, T. 133 N., R. 50 W.

M 30.99 Sections 14 and 23, T. 133 N., R. 50 W.

M 32.82 Sections 11 and 14, T. 133 N., R. 50 W.

M 35.11 Sections 10 and 11, T. 133 N., R. 50 W.

M 36.02 Sections 3 and 10, T. 133 N., R. 50 W.

M 37.98 Sections 3, T. 133 N. / 34, T. 134 N. R. 50 W.

M 39.20 Sections 33 and 34, T. 134 N., R. 50 W.

M 39.96 Sections 28 and 33, T. 134 N., R. 50 W.

M 42.14 Sections 21 and 28, T. 134 N., R. 50 W.

ANTELOPE CREEK EXISTING BRIDGES AND CULVERTS

M 43.43 Sections 17 and 20, T. 134 N., R. 50 W.

M 45.20 Sections 7 and 8, T. 134 N., R. 50 W.

M 42.44 Sections 20 and 21, T. 134 N., R. 50 W.

M 44.76 Sections 8 and 17, T. 134 N., R. 50 W.

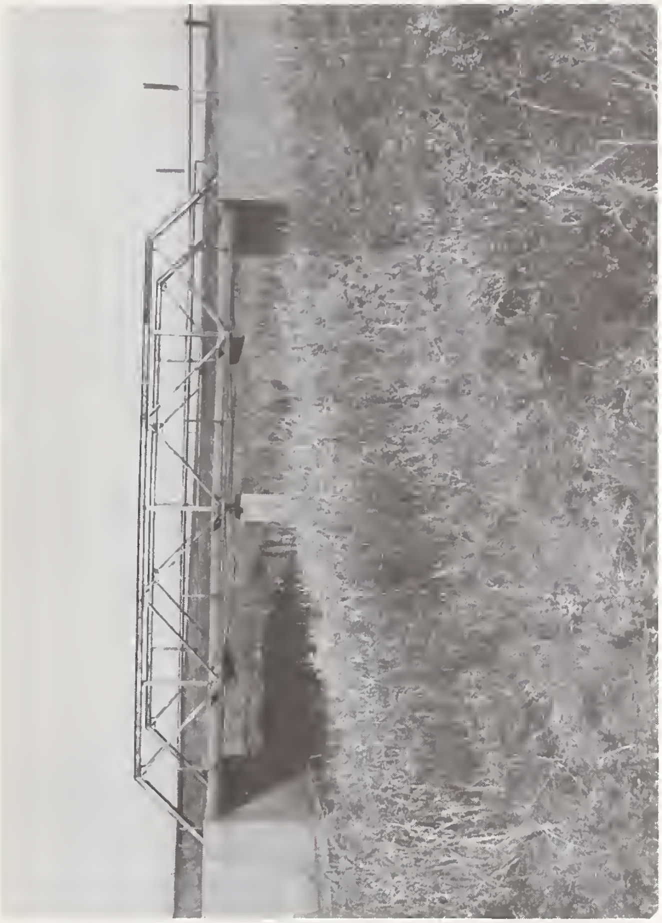
ANTELOPE CREEK EXISTING CULVERTS

M 45.42 Private Drive in Section7, T. 134 N., R. 50 W.

ANTELOPE TRIBUTARY EXISTING BOX CULVERT

M 1.60 Sections 15 and 23, T. 133 N., R. 50 W.

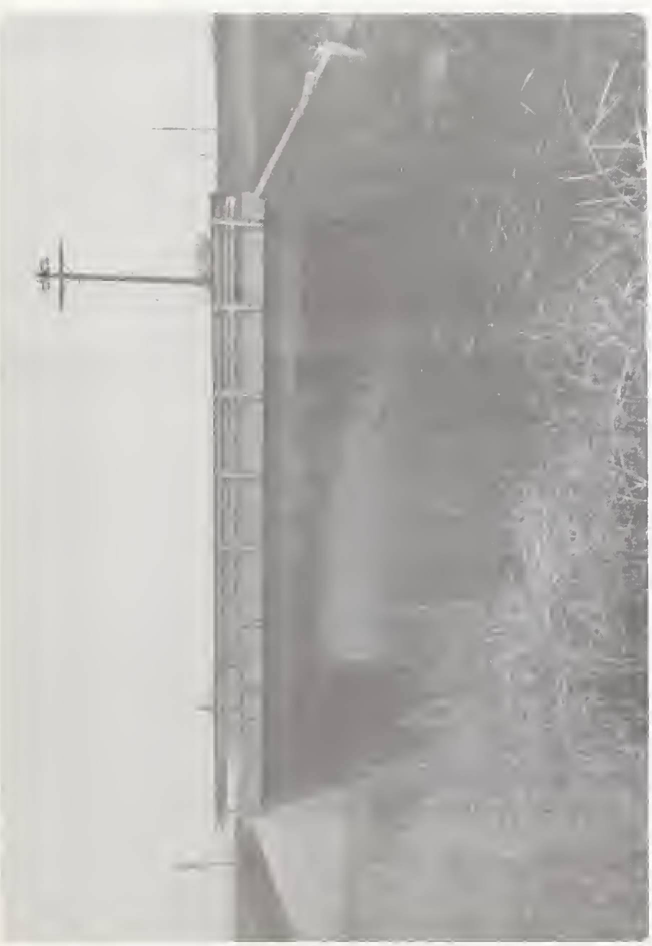
M 1.00 Sections 31, R. 48 W. / 36, R. 49 W. R. 133 N.



M 1.22 Sections 2 T. 132 N. / 36 T. 133 N. R. 49 W.

M 2.57 B.N. Railroad Sections 2 and 11, T. 132 N., R. 49 W.

M 3.51 ND Highway No. 13



M 4.18 Sections 10 and 11, T. 132 N., R. 49 W.

M 4.99 Private Drive in Section 15, T. 132 N., R. 49 W.

M 8.30 Interstate Highway No. 29

M 10.23 Sections 20 and 21, T. 132 N., R. 49 W.

M 11.98 Sections 19 and 20, T. 132 N., R. 49 W.

APPENDIX I

GLOSSARY

Acre-Foot -- The amount of water that will cover one acre to a depth of one foot. Equals 43,560 cubic feet.

Backwater -- The resulting high water surface in a given stream due to a downstream restriction or high stages in an intersecting stream.

Channel -- A natural or artificial watercourse with definite bed and banks to confine and conduct continuously or periodically flowing water.

Cubic Feet Per Second -- Rate of fluid flow at which one cubic foot of fluid passes a measuring point in one second (cfs).

Discharge -- The rate of flow or volume per unit of time. In this report discharge is expressed in cubic feet per second (cfs).

Flood -- An overflow of water onto lands not normally covered by water. The inundation is temporary and the land is adjacent to and inundated by overflow from a river, stream, ocean, lake or other body of standing water.

Flood Frequency -- An expression of how often a flood event of a given magnitude will, on the average, be equaled or exceeded. The word "frequency" often is omitted in discussing a flood event for the purpose of abbreviation.

Examples"

10-year flood or 10-year frequency flood - the flood which can be expected to be equaled or exceeded on an average of once in 10 years; and which would have a 10 percent chance of being equaled or exceeded in any given year.

50-year flood - ...two percent chance...in any given year.

100-year flood - ...one percent chance...in any given year.

500-year flood - ...two-tenths percent chance...in any given year.

Flood Peak or Peak Discharge -- The highest stage or discharge attained during a flood.

Flood Plain, Flood Prone Area or Flood Hazard Area -- Land adjoining a stream (or other body of water) which may be temporarily covered by flood water.

Flood Plain Encroachment -- Placement of fill or structures in the flood plain which may impede flood flow and cause backwater.

Flood Proofing -- A combination of structural provisions, changes or adjustments to properties and structures subject to flooding for the reduction or elimination of flood damages to properties, water and sanitary facilities, structures and contents of buildings in a flood hazard area.

Flood Routing -- Computation of the changes in streamflow as a flood moves downstream. The results provide hydrographs of discharge versus time at given points on the stream.

Flood Stage -- The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area.

Hydrograph -- A plotted curve showing the rise and fall of flood discharge with respect to time at a specific point on a stream.

Natural Storage Area -- In this report, refers to depressional areas, marshes, lakes and swamps that temporarily store a portion of the surface runoff.

Riparian -- Land bordering a waterbody or watercourse.

Runoff -- In this report, refers to the portion of precipitation (including snowmelt) that flows across the land surface and contributes to stream or flood flow.

Stage Discharge Curve -- A plotted curve showing the variation of discharge with water surface elevation at a point on a stream.

Stage-Storage Curve -- A plotted curve showing the accumulated storage available for floodwater upstream from a point on a stream versus the stage at that point.

Valley Cross Section -- The relationship of the elevation of the ground to the horizontal distance across a valley perpendicular to the direction of flow.

Watershed -- A drainage basin or area which collects and transmits runoff to the outlet of the basin.

Watershed Boundary or Drainage Boundary -- The divide separating one watershed from another.

Water Surface Profile -- The relationship of water surface elevation to stream channel elevation at points along a stream, generally drawn to shown the water surface elevation for the peak of a specific flood, but may be prepared for conditions at any given time.

APPENDIX J

ELEVATION REFERENCE MARKS

ANTELOPE CREEK FLOOD PLAIN MANAGEMENT STUDY

R.M. No.	Elevation (MSL)	R.M.'s Description
BM-1 1/	972.02	A standard disc stamped "19 KEE 1963" set in a concrete post at the NW corner of Section 29, T132N, R49W.
BM-3 2/	967.19	"X" cut in top of most southerly 7" I beam of wing wall at SW corner of bridge over South Branch of Antelope Creek 1350' ± south of NW corner of Sec. 21, T132N, R49W.
BM-7 2/	967.43	Chiseled " " in top of SE wing wall of bridge over Antelope Creek 0.4 miles north of Mooreton in Sec. 6, T132N, R49W.
BM-8 2/	957.55	Chiseled " " at NE corner of headwall on north side of Highway 13 over south branch of Antelope Creek.
BM-9 2/	954.64	Set railroad spike in pole at SW corner of junction of (2) roads at NE corner of Sec. 2, T132N, R49W.
BM-10 2/	957.09	Railroad spike in pile at NE corner of junction of (2) roads at NW corner of Sec. 31, T133N, R48W.
BM-11 2/	944.22	"X" cut in NE corner of bridge over Antelope Creek at NW corner of Sec. 32, T133N, R48W.
BM-12 1/	953.29	USGS disc stamped "2FK1958" 60' north and 75' east of center of Highway 81 at G.N. railroad tracks in Dwight.
BM-14 2/	955.54	Chiseled " " in SW corner of concrete curb at SE corner of bridge over South Branch of Antelope Creek along east line of Sec. 10, T132N, R49W.
BM-15 2/	964.71	Chiseled " " in SW corner of headwall of SE corner of I-29 bridge (northbound) and South Branch of Antelope Creek.

1/ Reference mark established by U.S.C.&G.S.

2/ Reference mark established for SCS by Tallamy, Van Kuren, Gertis and Associates.

R.M. No.	Elevation (MSL)	R.M.'s Description
BM-16 2/	965.89	Chiseled " " in top of most southeasterly steel channel of bridge over Antelope Creek at north line of Sec. 6, T132N, R49W.
BM-18 2/	962.94	"X" cut in rivet at NE corner of bridge over Antelope Creek at west line of Sec. 5, T132N, R49W.
BM-19 2/	969.21	Found rivet in top of concrete curb at NE corner of northbound I-29 over Antelope Creek at Sec. 4, T132N, R49W.
BM-21 2/	963.24	Railroad spike in pole #190 on south side of road along north line of Sec. 3, T132N, R49W and is 500' ± west of the middle crossing of Antelope Creek and road.
BM-22 2/	950.58	"X" cut in anchor bolt at NE corner of bridge over Antelope Creek at west line of Sec. 36, T133N, R49W.
BM-23 2/	970.28	Found "X" cut in steel channel at NW corner of bridge over Antelope Creek at north line of Sec. 31, T133N, R49W.
BM-24 2/	971.52	"X" cut in steel channel at NE corner of bridge over Antelope Creek at west line of Sec. 30, T133N, R49W.
BM-26 2/	981.72	Found "X" cut in steel channel at NW corner of bridge over Antelope Creek at east line of Sec. 23, T133N, R50W.
BM-27 2/	978.42	Chiseled " " in NE corner of concrete headwall of (2) 120" CMP on north side of road along south line of Sec. 14, T133N, R50W.
BM-28 2/	992.45	"X" cut in top of vertical I-beam (most westerly one of 3) for wingwall at southeast corner of Sec. 15, T133N, R50W.
BM-29 2/	1000.38	"X" cut in top of vertical I-beam of SE wingwall of bridge over Antelope Creek at west line of Sec. 15, T133N, R50W.
BM-30 2/	989.15	"X" cut in vertical I-beam at SW corner of bridge over Antelope Creek at south line of Sec. 11, T133N, R50W.

2/ Reference mark established for SCS by Tallamy, Van Kuren, Gertis and Associates.

R.M. No.	Elevation (MSL)	R.M.'s Description
BM-31 2/	996.86	"X" cut in steel channel at SW corner of bridge over Antelope Creek at west line of Sec. 11, T133N, R50W.
BM-32 2/	1000.53	"X" cut in SW corner of bridge over Antelope Creek at north line of Sec. 10, T133N, R50W.
BM-35 2/	1013.12	"X" cut in steel channel at SW corner of bridge over Antelope Creek at south line of Sec. 34, T134N, R50W.
BM-36 2/	1014.06	"X" cut in top of east end of most northerly of (3) 8' CMP for Antelope Creek at west line of Sec. 34, T134N, R50W.
BM-37 2/	1014.88	Found chiseled " " in NE corner of headwall for Antelope Creek at north line of Sec. 33, T134N, R50W.
BM-38 2/	1025.00	"X" cut in top of bolt at NE corner of bridge over Antelope Creek at south line of Sec. 21, T134N, R50W.
BM-40 2/	1027.07	"X" cut in steel channel at SE corner of bridge over Antelope Creek at north line of Sec. 20, T134N, R50W.
BM-41 2/	1028.32	"X" cut in most easterly one of (3) oval CMP's for Antelope Creek on north side of road along north side of Sec. 17, T134N, R50W.
BM-42 2/	1033.03	Chiseled " " in NE corner of concrete headwall for Antelope Creek and along west line of Sec. 8, T134N, R50W.
BM-43 2/	1036.71	"X" cut in steel channel at SE corner of bridge over Antelope Creek at north line of Sec. 7, T134N, R50W.
BM-45 2/	944.70	Found "X" cut on steel channel at SW corner of bridge over Antelope Creek (¼ mile south of the town of Dwight) on E line of Sec. 29, T133N, R48W.
BM-46 2/	949.29	Chiseled " " in concrete curb at NE corner of bridge over Antelope Creek at north line of Sec. 28, T133N, R48W.

2/ Reference mark established for SCS by Tallamy, Van Kuren, Gertis and Associates.

R.M. No.	Elevation (MSL)	R.M.'s Description
BM-47 2/	936.51	"X" cut in rivet at northwest corner of bridge over Antelope Creek at north line of Sec. 20, T133N, R48W.
BM-48 2/	935.42	Found "X" cut in steel channel at SE corner of bridge over Antelope Creek along north line of Sec. 17, T133N, R48W.
BM-49 2/	944.22	"X" cut in top of 30" CMP at east side of 90° bend in road at SE corner of Sec. 6, T133N, R48W.
BM-50 2/	926.38	"X" cut in steel channel at SE corner of bridge over Antelope Creek at north line of Sec. 5, T133N, R48W.
BM-52 2/	931.99	"X" cut in NE corner of bridge over Antelope Creek at north line of Sec. 31, T134N, R48W.

2/ Reference mark established for SCS by Tallamy, Van Kuren, Gertis and Associates.

APPENDIX K

BIBLIOGRAPHY AND REFERENCES

1. Hydrology - Section 4. August 1972. National Engineering Handbook. Soil Conservation Service. U.S. Department of Agriculture.

2. Guidelines for Determining Flood Flow Frequency. Bulletin #17A of the Hydrology Committee, Rev. June 1977. U.S. Water Resources Council. Washington, D.C.

3. Water Resources Data for North Dakota. Annual Reports. U.S. Geological Survey. Water-Data Report.

4. Extra Territorial Jurisdiction. North Dakota Century Code. Section 40-47-01. 1975.

5. Water Resources Council, United States. Regulation of Flood Hazard Areas, Vols. 1 and 2. Washington, D.C.: United States Government Printing Office, 1971 and 1972.

6. A Perspective on Flood Plain Regulations for Flood Plain Management. Department of the Army, Office of the Chief of Engineers, Washington, D.C. 1976.

7. Flood Proofing Regulations. DOA, OCE, Washington, D.C., 1972.

8. A Report by the Task Force on Federal Flood Control Policy, House Document No. 465 (89th Congress, Second Session).

9. Public Law 83-566 Watershed Protection and Flood Prevention Act.

10. Executive Order No. 11988, May 24, 1977, Flood Plain Management.

11. Soil Survey of Richland County and Sheyenne National Grassland Area of Ransom County, North Daktoa, Published by the USDA Soil Conservation Service and Forest Service in cooperation with the North Dakota Agricultural Experiment Station, Dec. 1975.

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